Natural Science

A Monthly Review of Scientific Progress

JULY 1899

NOTES AND COMMENTS.

The Animal Mind.

IN the June number of *Natural Science* we had occasion to remark that comparative psychology is the most anarchic department within the naturalist's province. This is due to several causes: in part to the fact that, as we said, this field is often a happy hunting-ground for the crank, in part to a lamentable want of agreement in the use of psychological terms, and in part to the lack of any co-ordinated body of critical and adequately-trained opinion on the subject. The average press critique of a work on the instincts and intelligence of animals reveals the fact that there are comparatively few men to whom an editor can appeal with confidence that they have a sufficient background of knowledge to enable them to realise the true nature of the problems which are discussed. The more popular and superficial the interpretation in a work under review, and the more closely it accords with the current prejudices of those who, without special study, think they understand, not only mental products, but (a far more difficult matter) the subtle processes by which they are reached, the more likely is it to be hailed as the expression of the "plain common sense view of the question."

Two articles are devoted to comparative psychology in the May number of the *Psychological Review*: one by Prof. Wesley Mills on "The Nature of Animal Intelligence, and the Methods of investigating it"; the other by Prof. E. Thorndike on "The Instinctive Reaction of Young Chicks." The main object of the former writer is to criticise some of the previous work of the latter. The monograph by Prof. Thorndike thus criticised was reviewed in these pages by Prof. Lloyd Morgan, who urged, *inter alia*, that the method adopted by its author, that of placing starving cats in cramped cages, was unsatisfactory. This, too, is the burden of much of Prof. Wesley Mills' criticism. And so far he is on safe ground—ground which, as an independent observer, he knows well. But when he deals with psychological criticism the plane of his analysis is so different from Prof. Thorndike's, that little of value comes out of his discussion. He will, we think, enlist the sympathies of the uninstructed, rather than those of serious students of

psychology. He has himself published observations of interest and value—modestly asserting that he "has recorded more experiments (not to mention scores which he has not described) than all other investigators together, if we except those working on insects." But in analysis and interpretation he has not shown himself strong. It is questionable whether his discussion of imitation and memory, for example, have any real bearing upon Prof. Thorndike's contentions. Indeed, at one point he seems to dimly realise this, for he says: "To be sure, there is a sort of deliberate, studied, high-class imitation possible to man, but beyond the reach of animals." But he does not appear to grasp the fact that it is just the occurrence in animals (save, perhaps, the Primates) of such imitation which Prof. Thorndike questions. Speaking of "free floating ideas," Prof. Mills says: "The believer in evolution will demand that, in this and other cases, in which qualities man possesses are denied to animals, there be the clearest proofs given. The burden of proof lies with those who deny them." With this assertion many psychologists entirely disagree; and Prof. Wesley Mills' *ipse dixit*, without adequate discussion, will not lead them, we imagine, to alter their opinion. It is strange that Prof. Lloyd Morgan's name should be mentioned as that of one who holds the view "that we must always adopt the *simplest* explanations of an animal's action," seeing that in his "Introduction to Comparative Psychology" (p. 54), he urges that the simplest explanation is *not* that which we should necessarily accept.

Prof. Thorndike's article deals with young chicks. His observations tend, on the whole, to confirm those of previous investigators, but add some interesting facts. The newly-hatched birds were found to peck at small (2 mm.) squares of coloured paper on backgrounds of white and black. The observations are not sufficient in number to justify conclusions as to colour preference; but they suffice to establish the fact that the patches, either from their colour or their light intensity, afford the requisite stimulus to the pecking response. Mr. Thorndike found that chicks from ten to twenty days old ate bees greedily, "first mashing them down on the ground violently in a rather dextrous manner." It is probable, however, that they would not have touched them had they been stung then or at an earlier stage in their experience. He makes a point here against Prof. Lloyd Morgan, who states that a young bird dropped a bee, shook his head, and wiped his bill on the ground, "probably because he had tasted the poison." This statement, indeed, hardly seems to accord with Lloyd Morgan's own later observations of the eating of wasps and bees by young birds of several kinds. Other noteworthy facts which Prof. Thorndike records, are that young chicks placed in water will swim, and that, prior to experience, they will not leap down from a height of 39 inches, though they will do so at once from a height of 10 inches or less, and after some hesitation from heights of 16, 22, and 27 inches. In general

Prof. Thorndike thinks that too much stress has been laid on the definiteness of instinctive response, saying that the same stimulus does not always produce exactly the same effect in all individuals. But much depends on the meaning of the phrase "the same stimulus." It is at least possible that some part of the difference in response is due to slight difference in the stimuli and the "situation." But there are, no doubt, also differences in the individual characters of the birds (as all observers will be ready to admit) which lead to divergences of behaviour under quite similar circumstances. In any case the observations which Mr. Thorndike here describes were well worth placing on record.

The Art of Self-Defence.

In the struggle for existence plants have specialised along the line of passive resistance. It is by this method, as Professor Stahl showed long since, in his famous essay on "Pflanzen und Schnecken," that many are saved from snails whose appetite is spoiled by the bitters and alkaloids which many plants contain, and in half a dozen other ways. Dr. Bokorny has worked out the same idea in reference to fungi, pointing out that there are many common vegetable substances which are almost fungus-proof, and that is saying a good deal. In his essay (*Biol. Centralbl.* xix. 1899, pp. 177-185) he shows how the self-preservation of plants against fungi is secured by stuffs like tannin, oxalic acid, ethereal oils, the lupulit of hops, and so on. He gives his thesis greater solidity by a table of the more important vegetable substances, their occurrence, and their relation to bacteria and other fungi. It must of course be borne in mind that this indication of a secondary advantage should in no wise be allowed to make us more sluggish in trying to find out the primary physiological import of these results of metabolism.

Trustees of the British Museum.

No one need quarrel with the latest election to the Honourable Board of Trustees of the British Museum, in the places of the late Baron Ferdinand Rothschild and Charles Drury Fortnum. The Hon. Walter Rothschild is a keen zoologist on a spacious plan, and one who has never allowed the interests of his own admirably worked museum at Tring to conflict with the friendship he so frequently displays for the Natural History Museum. Sir Henry Howorth is known to our readers, not merely as a learned historian of human and pre-human times, but as an enthusiast on matters of museum arrangement and equipment. A little keenness is a welcome leaven in a body of men appointed for the most part for any reason other than interest in museum matters.

The Scaly Squid.

SOME four years ago Professor Joubin of Rennes astonished the scientific world by the announcement that the Prince of Monaco had obtained from the stomach of a sperm whale the trunk of a large cephalopod covered with scales. Some light has been thrown upon this curious structure in a recent paper by Dr. Einar Lönnberg in the results of "Svenska expeditionen till Magellansländern." This author describes a very complete example of *Onychoteuthis ingens*, in which the pallial surface had a peculiar warty appearance. In transverse section there were visible, between the muscular layers and the epidermis, large flat papillae, some 4 mm. in diameter by 1 mm. thick. In the spirit specimens the skin had sunk down between the papillae, giving the surface of the body the appearance of irregular tiles paving an old-fashioned street. On microscopic examination each papilla is found to be made up of a parenchymatous-looking mass of connective tissue. Dr. Lönnberg points out that if the integument were removed, as had been done in Joubin's specimen by the digestive action of the cachalot, the papillae would present the appearance of the scales described by that author. Regarding the function of this organ Lönnberg suggests that it may be an adaptation "to hydrostatic pressure when the animals descend to great depths;" and he mentions that a gelatinous subcutaneous structure has been observed in other deep-sea cephalopods, such as *Alloposus* by Joubin, and in large species of *Ommastrephes* by Steenstrup.

Echinoderms at the British Museum.

UNDER the new Director, additions and improvements continue to be introduced at the Natural History Museum, London, with no less rapidity than in the days of Sir William Flower. The gallery devoted to recent echinoderms and worms, which groups are in the hands of Mr. F. J. Bell, has for some little time been changing for the better. Several examples of the softer-bodied forms, such as cannot be displayed in the dry state, are now beautifully mounted in spirit, while, in the case of the holothurians, the form and colouring of the living animal is shown by a series of sketches of the living holothurian of Ceylon, prepared under the direction of the late Dr. Ondaatje. There are two charming water-colours, we believe by Mr. C. Berjeau, of the rosy feather-star and the holothurian, *Cucumaria crocea*. Similar drawings adorn the coral gallery, and are a vast improvement on the usual class of wall-diagrams one sees in museums. Dried holothurians are not forgotten, for, as every schoolboy knows, they form an important article of diet in the far East under the name of Trepang;

and we have heard that it is proposed to devote rather more attention to the economic aspects of zoology than has hitherto been the custom at the Natural History Museum. Consequently the seeker after new delicacies can now see in this gallery a series of specimens of Trepang, purchased in the Canton fish-market, and presented by George Tradescant Lay, Esq.; he can learn their zoological and their vernacular names, the character of the food afforded by each, and the market price. A table-case with dark red velvet ground and buff labels (not unlike those in the U. S. National Museum) is a pleasing experiment in museum-installation, and undoubtedly shows off the tests of sea-urchins and star-fish to great advantage. Some exceedingly choice specimens are mounted under glass shades fixed on the table-cases. There are *Diadema saxatile*, a sea-urchin with unpleasantly long spines, presented by Dr. J. Anderson; two finely preserved brittle-stars, *Pectinura maculata*, brought from New Zealand by H.M.S. *Challenger*; and a monster *Echinus esculentus* from Plymouth, presented by C. Stewart, Esq.

Accessions to the Natural History Museum.

An innovation that is of practical value, and that should increase the interest of the public, is the assignment of one of the alcoves in the central hall of the Natural History Museum to the exhibition of specimens recently acquired. In this way those familiar with the Museum are less likely to overlook important accessions in the vast mass of accumulated material, while those whose familiarity is less than it should be will have their sluggish interest aroused by the mere statement that what they are looking at is "something new," for in this respect all men are Athenians. Hitherto the exhibits in this alcove have been confined to zoological specimens, perhaps because the Director is also keeper of the Zoological Department. The following have been on view: Fish, mollusca, and other invertebrata, from Lake Tanganyika, collected by Mr. J. E. S. Moore, illustrating the marine origin of the fauna and its antique character. Fish from the river Congo, described by Mr. Boulenger (*Annales Mus. Congo*), and presented by the Secretary of State of the Congo Free State. *Lepidosiren paradoxa*, collected in the Paraguayan Chaco by Mr. J. Graham Kerr. A collection of rare birds from Patagonia and Argentina, presented by Dr. F. P. Moreno, director of the La Plata Museum. The splendid Hexactinellid sponges from Japan, to which we have previously referred. A male *Cervus sica manchuricus* in full summer coat,—a splendid specimen, presented by the Duke of Bedford. And a large specimen of the Tarpon fish, *Megalops thrissoides*, captured off Florida by Mr. Otis A. Mygatt, and presented by H.R.H. the Prince of Wales.

Bryozoa and Bipolarity.

SIR JOHN MURRAY may take heart again. His attempt to explain the similarity between the north and south temperate faunas has been met by more that one specialist (even among those quoted in support of his argument) by a denial of the similarity, at all events to the extent assumed by the bipolar hypothesis. But now comes a lady to defend the knight. Miss Edith M. Pratt, of Owens College, Manchester, has been studying some collections, chiefly of Bryozoa, made on the shore of the Falkland Islands (*Manchester Memoirs*, vol. xlii. No. 13, 14th December, 1898). After a careful analysis of the distribution of the genera, she concludes that the results "*as far as Bryozoa are concerned*, seem to support Murray's theory." "Each genus represented in the collection occurs fossil, and also occurs in the north and south temperate zones, as well as in the tropics; in fact most of the genera are cosmopolitan. Many of the *species* are represented in the *Tertiary deposits*. This shows that the changes of climate and the altered conditions of life have not affected their 'Tertiary' structure; as many of these forms occur only in the two temperate zones, there is reason to believe that they have retained their common ancestral structure. The fact of many of the species occurring in the deep sea hardly supports Ortmann's theory [that an exchange of polar forms can take place through the deep sea], for many of them occur at very great depths only in the temperate regions; in the *tropics* they occur in *shallow* water. Their presence in the deep sea is, I think, the result of accident."

It is pleasing to find some attention paid to distribution in former geological periods; but does Miss Pratt, or can Sir John Murray, suppose that what took place in Tertiary times has much bearing on the question? It cannot seriously be maintained that there was any appreciable difference of world-temperature so recently as the Tertiary; certainly there was no approach to a universal climate in those days. We have to go back a good deal farther before our facts can bear any relation to the primal temperature of the globe. If there be a similarity between the present polar faunas, we do not see how any identity of species can be due to events that took place, if at all, in early Palaeozoic ages. As for certain cases of distribution being "the result of accident," what can Miss Pratt mean? It is too easy a way of explaining inconvenient facts.

Miss Pratt also studies the distribution of Anthomedusae, Porifera, Polychaeta, Gephyrea, Mollusca, Echinoderma, Crustacea, and Tunicata. Out of twenty-four species, three have been recorded from north and south temperate regions only; one from north and south temperate regions and the tropics; one from tropics and southern hemisphere; and all the rest from the southern hemisphere only. These facts scarcely show a striking similarity between the temperate faunas of the

northern and southern hemispheres. But, whatever conclusions may be drawn, the paper at least is one that does credit to the Zoological Laboratory of Owens College.

More about "Bipolarity."

DR. ARNOLD E. ORTMANN of Princeton, who pointed out in 1894 that the facts in regard to the distribution of Crustacea did not fit in with the "Bipolarity hypothesis," has some further remarks to make on the subject. He has been waiting, he says, for some definite expression of results from those who have been working at the "Hamburger Magelhaensischen Sammelreise," and he is disappointed. Perhaps Dr. Pfeffer's lecture at the annual meeting of the German Zoological Society—which he has promised to send us as soon as possible—may afford further light on the problem to which we recently referred in our summary of Professor D'Arcy Thompson's paper. The *onus probandi* seems to lie with the upholders of the hypothesis, but we wish that Dr. Ortmann would send us something more satisfactory than his recent note (*Zool. Anzeig.* xxii. 1899, pp. 214-216), which makes only one point, namely, that seven authors who have recently dealt with the question are all on his side. It seems absurd to lose good-humour on such a question, and even if Dr. Ortmann feels that he has ground for irritation it is a mistake to make this apparent. The proper safety-valve is an article in *Natural Science.*

Natural Science in Australia.

THE Report of the seventh meeting of the Australasian Association for the Advancement of Science is a bulky volume of 1160 pages, which is full of interesting material, and affords abundant evidence of the activity of scientific life in Australia. The President, Professor A. Liversidge, who also edits the Report, dealt in his address mainly with some of the recent advances in physics and chemistry. Among the reports and papers more especially bearing upon natural science, we may notice those on glacial boulders in Central Australia, and on vernacular names of Australian birds; Captain Hutton's address on Early Life on the Earth (previously referred to in our columns); Dr. C. J. Martin's address on the history of the relations between morphology and physiology during the last fifty years; Mr. F. Manson Bailey's "few words" on the flora of the Torres Straits; Mr. J. F. Bailey's beautifully-illustrated paper on the plants of the rabbit-infested country in the Bulloo River district; Mr. A. J. Campbell's memoir on the

nests and eggs of the honey-eaters; Mr. W. J. Rainbow's observations on the long range of vision in spiders of the families Citigradae and Attidae. But this gives a mere hint of the interest of the volume. The president notes that the length of the journey often involved in a visit to a meeting of the Association necessarily tells on the attendance of members, and has led to the substitution of biennial for annual sessions, and he counsels the establishment of local scientific societies which would tend to increase the roll of working members. At the same time, that the plan of meeting biennially is a success as regards quality is evident from the stimulating and wholesome contents of this Report.

The Colouring Matter of Blue Coral.

PROF. LIVERSIDGE has made a series of experiments on the blue pigment of *Heliopora coerulea* on material obtained by the Funafuti Expedition. His results are interesting, although they do not, unfortunately, throw much light upon the nature or relations of this very curious pigment. He finds that "dead" coral after treatment with hydrochloric acid yields a black pigment which dissolves in formic, acetic, and lactic acids to form a bright blue solution. The pigment is slightly soluble in absolute alcohol, but quite insoluble in ether. The residue after ignition is bulky, and contains much phosphoric acid, iron, lime, and magnesia. Curiously enough Prof. Liversidge found that pieces of "live" coral, or coral which had been gathered while growing, although of a distinct slaty blue colour, did not yield blue solutions, but merely pale green ones. The pigment itself was also of a pale chlorophyll green tint. The paper concludes with a list of other blue or green colouring matters in animals. In connection with these we would draw the author's attention to the asserted occurrence of the mineral vivianite in the skeleton of *Belone* and some other forms.

Zoology in Brazil.

THE December number of the *Boletin* of the Pará Museum bears witness to the continued energy of the zoologists and botanists attached to that institution; the greater portion of the present issue being (as has so frequently been the case with its predecessors) from the pen of the learned director, Dr. E. Goeldi. Perhaps the most important item in the fasciculus is the article on the fishes of Amazonia and the Guianas, in the course of which a number of new species recently described by Mr. Boulenger are referred to. And attention may here be specially directed to the exceeding excellence of

execution and beauty of coloration characterising the double plate by which this article is illustrated. Our only regret is to find no mention of the habits of the various species of fishes referred to, although there is not improbably a sufficient reason for the omission.

That the habits of animals are not overlooked is amply demonstrated in the article headed "A Senda Amazonica du 'Caure.'" This deals with a beautiful little kind of nest, containing a single egg, which had long been attributed to *Falco rufigularis*, the "Caure" of the Brazilians. Struck with its resemblance to the nest of the Oriental *Collocalia nidifica*, Dr. Goeldi came, however, to the conclusion that it must be the work of one of the Tree-Swifts. And actual observation has proved the truth of the conjecture; the real builder being *Panyptila cayanensis*.

Other articles deal with the natives of Brazil, with the spiders of the country, and with the flora of Amazonia. A plate illustrating two species of monkey belongs to an article issued with an earlier part.

According to the Fancy of the Speller.

An attempt has often been made by embryologists to distinguish between those processes of development which appear to express an adherence to the mode established in the long evolution of a race (palingenetic processes), and those which appear to express readjustments or new departures adapted to conditions of relatively more recent date (kainogenetic processes). Thus it might be said that the development of a paired (epiphysial) upgrowth from the fore-brain was a palingenetic process, while the particular fate of these upgrowths or of one of them (which is very diverse in different types) is kainogenetic. There are some to whom the distinction seems of paramount importance, there are others who deny its legitimacy altogether, while a third position is that of those who recognise the distinction as an attempt to discriminate the relative age of the establishment of a developmental process, but find it exceedingly difficult to establish this in practical detail.

But, supposing the distinction be admitted as legitimate, what is its proper terminology? Keeping to the one root, καινός = new, we find, as Dr. Ernst Mehnert points out (*Anat. Anzeig.* xvi. 1899, pp. 29-31), cenogenesis, kenogenesis, cenegenie, caenogenese, and cänogenese. Our acumen is not sufficiently specialised to distinguish between the last two, but what about the others, in regard to which Mehnert writes, in response to the hot irons of criticisms, with some forcefulness? As κενός means empty or worse, as coenum or caenum means dirt or worse, as the announcement of a book on caenogenesis provoked the most violent astonishment ("heftigstes Staunen"), as the author, whose work

was discussed in the last volume of *Natural Science*, had dictionaries sent, if not hurled, at him, we think that he was right—for this is an age of compromise—in sticking to kainogenesis, and he seems to have Gegenbaur and other great authorities on his side. But to those who believe that kainogenesis is a term for an empty conception, the reading cenogenesis will doubtless seem preferable, for the German lexicon states that κενός means (1) leer, (2) vergebens, (3) eitel, (4) müssig, (5) ausgeleert. But, after all, the gist of the matter is rather that we should be sure that there is such a distinction as that between kainogenetic and palingenetic, before we become excited in regard to our spelling of it.

Flora of Sand Dunes.

THE flora of sand dunes has always been of great interest to botanists from the number of peculiar species which it offers, and also—especially more recently—from its remarkable oecological importance. The climatic and soil conditions under which it exists are so extreme in character, and vary so continually, that it offers a suitable field for the study of many problems dealing with the interaction of plants and their environment. Partly from this reason, and partly because of the absence of any complete study of dunes beside fresh water, Dr. H. C. Cowles of Chicago University has just published (*Bot. Gaz.* xxvii. 1899, Feb. to May, Fig. 26) an elaborate account of the general relationships of the dune vegetation of the shores of Lake Michigan. This paper is the first of a series on the subject, and treats of the geographical aspect. The extent of the whole area considered is great, but most attention is paid to the south-east coast of the lake, where the dune formation attains its maximum development—being largely due to the action of north-west winds.

In comparing those dunes to these familiar to observers in Europe the resemblances are much more conspicuous than the differences. It is remarkable how well many of the descriptions might be applied to the dunes around the British coast, if only the names of the species of plants were replaced by those of their European equivalents. Thus on the beach, where we should find *Cakile maritima*, Dr. Cowles records *C. americana*. On the loose dunes of both continents *Ammophila arundinacea* is the dominant and most important sand-binding grass. The plant associations in both cases include those of the xerophytic ridges, the intermediate swamps, and the mesophytic woods. In this country *Salix repens* fringes the travelling dune, in Michigan it is replaced by *S. glaucophylla* and *S. adenophylla*; here *Pinus sylvestris* and *Betula alba* are the dominant trees on the fixed dunes, there it is *Pinus banksiana*, *Betula papyrifera*, *Thuya occidentalis*, *Fraxinus americana*, etc. Many of the observations made by Dr. Cowles with

regard to the movement of dunes have their correlatives in this country. In this as in other ways the paper claims as much attention from European students as from those in America. The author suggests the problem offered by the presence of so many maritime and salt-loving species along the shores of a fresh-water lake, but reserves his explanation for a future paper, where he will particularly consider the oecological adaptations of the plants. The paper is profusely illustrated by process-blocks from photographs which, although they have undoubtedly suffered in reproduction, yet add greatly to the interest and value of the work, and aid in rendering it one of the most important oecological studies which has yet appeared in the United States.

Galway Natural History Museum.

We have from time to time given accounts of local museums, and our contemporary the *Irish Naturalist*, following our example, has in its June number a description of the Natural History Museum, Queen's College, Galway, by Prof. R. J. Anderson. From this interesting account we select two paragraphs:—

"Metropolitan museum authorities have sought to give a natural character to their collections, which one seeks for in vain amongst the average stuffed animals with their sleepless eyes and too cowering or too rigid pose. The example so well set has been followed here. One case represents a tug-of-war between an owl and a stoat, the rope is represented by a rat. Another shows the platypus at home with the avenues to his burrow by water and land; a third shows a peregrine and a slain rabbit; a fourth, a number of water birds with scenery; a fifth, the hornbill at home; a sixth, a fox interested in a woodcock; a seventh, an owl giving portions of a dead bird to its young; and eighth, a stoat with water birds, water, a dace, and a water-beetle; a ninth—a spider with a humming bird in his clutches."

"Proximity to the sea makes it possible to secure quite a number of living specimens. . . . I note on a window, as I write, a good many invertebrate types, living and well, sea-anemones and starfish, nereids and periwinkles, crabs and tunicates, crickets and spiders. In one tank are frogs and fresh-water mussels, in another tadpoles."

Botanical Biography.

We are glad to note the issue as a separate publication of the first supplement to Messrs. Britten & Boulger's Biographical Index of British

and Irish Botanists. It includes the botanists who died between January 1, 1893, and December 31, 1897, and also several who were omitted from the original Index, comprising together about 250 entries. There are a few well-known names, such as Babington of Cambridge, Huxley (whose claim as a botanist rests on a paper on gentians), Williamson, the expositor of the plants of the coal-measures, Bentley of the Pharmaceutical Society, his one-time associate author Trimen of Ceylon; but the great majority are not widely known, and many are to hand only as the result of painstaking research. By recording so many of these obscure, but often extremely useful workers, the authors of this Index have rendered a lasting service to Botany, and we shall hope for a regular recurrence of the supplement as time and botanists pass.

A New Found Trilobite from Newfoundland.

THE trilobite which Dr. G. F. Matthew has recently described in the *Bulletin Nat. Hist. Soc. New Brunswick* (vol. iv. No. 17, 1899) is of considerable size. The head shield is more than six inches wide, and the movable cheek with its greatly produced genal spine is about seven inches long. Its principal interest appears to consist in its supplying "a new link between the Cambrian of Europe and that of America." For certain Cambrian trilobites discovered in Sardinia, Bornemann founded the genus *Metadoxides*, characterised by a conical glabella as distinguished from the club-shaped glabella of the older genus *Paradoxides*. The glabella is conical in Dr. Matthew's new species from the Lower Cambrian beds of Newfoundland, and he describes it under the name *Metadoxides magnificus*. But he urges that it is a more primitive member of the genus than the Sardinian species, and, moreover, that *Paradoxides*, though older in name, is not older in nature than *Metadoxides*. He gives reasons for supposing that trilobites migrated from New Brunswick through Newfoundland to Southern Europe. To emphasise his views on the succession in time of various species, at the close of his article he proposes to divide the genus *Metadoxides* into three sub-genera, the first and eldest being *Catadoxides*, with the new *magnificus* for its exemplar. The late Henri Milne Edwards refused to accept the separation of *Olenus* from *Paradoxides* as a needless new-fangled addition to overburdened nomenclature. We can imagine, therefore, how charmed he would have been to be confronted not only with *Olenus* and *Protolenus*, and *Olenellus* and *Olenopsis*, but also with *Catadoxides*, *Metadoxides*, *Anadoxides*, the three sub-genera or infant progeny of *Metadoxides*, with the second child endearingly named after its parent.

Mexican and Central American Squirrels.

In the first volume of the *Proc. Washington Acad.* (pp. 15-106), Mr. E. W. Nelson attempts a revision of the species of squirrels inhabiting Mexico and Central America. In these days of "scrappy" papers, it is always refreshing to meet with anything of the monograph type; and a welcome should therefore be extended to this communication, even if we fail to accept all its conclusions.

The most generally interesting part of the paper deals with the degree of development of the fur of these rodents, according to the nature of the climate they inhabit. "The effect of climate," writes the author, "on the character of the pelage is so marked, that it is possible to tell with considerable certainty whether a species belongs to the tropics or to the higher mountains. Tropical species have thin pelage, short thin under-fur, and coarse, stiff, or almost bristly dorsal hairs; those of the Transition and Boreal zones have thick, soft pelage, with long dense under-fur. . . . Species of the hot coasts of Central America are characterised by peculiarly coarse, shining, bristly dorsal hairs. Seasonal differences in pelage are usually slight, since there is no area of heavy snow-fall or long-continued cold weather except in the Sierra Madre of Durango and Chihuahua. Individual variation, on the other hand, is often excessive, and renders some species extremely difficult to describe."

This, so far as it goes, is zoology in its highest and best sense. With regard to the descriptive portion of the paper, it must suffice to say that while the author finds it necessary to split up the genus into a number of groups, it is satisfactory that these are regarded in the light of sub-genera rather than distinct genera.

Spinning at Dawn.

Dr. Emil A. Goeldi, the enthusiastic director of the museum in Pará, tells an interesting story of an early rising spider—*Epeiroides bahiensis* Keyserling by name. The spinner was common in his garden, but the web defied discovery until Goeldi's son Walther, a boy of seven, sat up to detect the trick. The fact is that the spider makes its web in the early hours, and rolls it up and decamps after the sun rises. Penelope-like it destroys its web daily, but not without result to man as well as to itself, for it catches the minute winged males of the destructive Coccidae, of *Dorthesia americana* in particular. After retiring under the shade of a leaf the spider investigates the insects in its rolled up net, and spends the hot hours in digesting them. Its behaviour reminded Goeldi of a southern bird-catcher hastily gathering his roccolo together as the dawn breaks, but with this difference that

the spider "does not stop to pull out the captives, wring their necks, and throw them into a bag. It gathers up its net and postpones the work of revision until it gets home." This interesting paper will be found in *Zoologisches Jahrbuch*, xii. (1899), pp. 161-169, 1 pl. and 1 fig.

E pur si muove!

WE could not find a finer instance of the progress of science—which it is part of the function of our journal to record—than Dr. (now Sir) J. Burdon Sanderson's Croonian Lecture, delivered to the Royal Society of London on March 16, "On the relation of motion in animals and plants to the electrical phenomena which are associated with it."

The progress to which we refer might be best indicated by a summary of the actual results and suggestive hints to which the lecture gives expression, but it seems more picturesque and not less important to cite the first two paragraphs, for they indicate as it were graphically the strides of modern physiology to which the baronet's genius has given so much force.

"In a Croonian Lecture which I delivered to the Royal Society in 1867—more than thirty years ago—I exhibited a number of diagrams of graphic records in evidence of the mechanical relations which I then sought to establish between the movements of the heart and those of respiration in the higher animals.

"I have to-day to bring before you results which have also been obtained by a graphic method, which however differs from the other in that the records are written by light, and not by pen on paper; that the time taken in recording is measured in thousandths of seconds, not tenths; and finally, that the events recorded are not the movements of the chest or heart, but the electrical changes which, as will be shown, are found to associate themselves with all manifestations of functional activity in living organisms, whenever these take place under conditions which admit of their being investigated."

A Complementary Male.

MANY years ago Darwin discovered a little creature living on the barnacle, *Scalpellum vulgare*, which he at first regarded as a parasite and afterwards as a "complementary male." In other cases, as is well known, he found a similar dimorphism,—minute complementary males fixed to the hermaphrodite barnacles, and in some rare species to females. Since Darwin's work there has been little if any re-investigation of the complementary male of *Scalpellum vulgare*, but it has recently

found a careful student in Mr. A. Gruvel (*Arch. Biol.* xvi. 1899, pp. 27-47, 1 pl.). In Hoek's *Challenger Report* there is some account of the complementary male of *Sc. regium*, which is said to have two ganglia, a functionless stomach, and cement glands, but not much else. In the species studied by Gruvel the male is also very simple. It has two ganglia and an eye, but no digestive canal nor specialised vascular and respiratory apparatus. It is little more than an independent testicle endowed with a minimum of individuality.

Mr. Gruvel finds it difficult to admit that similar eggs fertilised by spermatozoa of the same origin produce larvae destined to give rise, some to hermaphrodites and others to these pigmy males. And so he has thought out a theory which may render the affair less mysterious, though we are not at all confident that it does. Cirripeds are usually protandrous, *i.e.* the spermatozoa ripen before the ova. The sperms are shed first, and accumulate in the interpallial space. By and by the ova pass into the ovigerous sac, and are there fertilised; as they develop, the gaps in the sac are closed, and the whole is detached from the genital atrium to be fixed to the ovigerous frenum. Thereafter there emerge belated ova which have a poor chance of being fertilised by the spermatozoa of the hermaphrodite. And Gruvel's theory is that these are fertilised by the spermatozoa of the complementary male, which are usually longer of developing than those of its bearer, and that from these ova thus fertilised complementary males are produced.

Is Fertility Inherited?

In the sixth of his valuable memoirs entitled "Mathematical Contributions to the Theory of Evolution," Prof. Karl Pearson, with the assistance of Miss Alice Lee and Mr. Leslie Bramley-Moore, brings forward evidence to show that fertility is inherited in man, and fecundity in the horse, "and therefore probably that both these characters are inherited in all types of life"—in all likelihood according to the Galtonian rule. We have only seen the abstract in the *Proceedings of the Royal Society* (lxiv. 1899, pp. 163-167), but that is enough to show the interest and importance of this inquiry, especially in connection with "reproductive or genetic selection"—a term (which seems to us unfortunate) used to describe "the selection of predominant types owing to the different grades of reproductivity being inherited, and without the influence of a differential death-rate."

Mr. Pearson points out that the problem of whether fertility is or is not inherited is one of very far-reaching consequences. "The inheritance of fertility and the correlation of fertility with other characters are principles momentous in their results for our conceptions of evolution; they mark a continual tendency in a race to

progress in a definite direction, unless equilibrium be maintained by any other equipollent factors, exhibited in the form of a differential death-rate on the most fertile."

He seeks to force biologists to face a dilemma. If the above principles are accepted, then the biologist "must look upon all races as tending to progress in definite directions—not necessarily one, but possibly several different directions, according to the characters with which fertility may be correlated—the moment natural selection is suspended; the organism carries in itself, in virtue of the laws of inheritance and the correlation of its characters, a tendency to progressive change." If, on the other hand, the biologist does not accept the principles, then he must be prepared to meet the weight of evidence in the memoir. But is it not fair to remark that this evidence relates to two highly artificial cases—man and the race-horse?

Living Fossils.

WHETHER Mr. J. E. S. Moore is correct or not in his interesting hypothesis that Lake Tanganyika represents an old Jurassic sea, and that many of the molluscs in it are long-lived relicts of Jurassic fauna, he must get credit for his careful and enthusiastic endeavours to make good his case. We believe that there are some who are in no way convinced, and it was with interest therefore that we read Mr. Moore's continuation of his previous studies on the molluscs of this great lake (*Quart. Journ. Micr. Sci.* xlii. 1899, pp. 155-201, 8 pls.), in which he deals with forms called *Tanganyika rufofilosa, Spekia zonata, Nasopsis nassa*, and *Bythoceras howesii*, which he found on the picturesque shores, or dredged from the deep waters.

His conclusion, on which it would be unfair to throw doubt without detailed criticism, is that all the evidence which has been collected concerning the nature of the halolimnic Gastropods invariably points to the vast antiquity of these forms. "First we have the wide dissimilarity of their empty shells from those of any living types; next their rigid isolation to a solitary great lake, which, judged from whatever standard we may choose to adopt, is unquestionably of an enormous age. Next we have the wonderful similarity of the halolimnic shells now living in Tanganyika, to those which have been left fossilised at the bottom of the old Jurassic seas; and lastly, there are the morphological characters of the halolimnic animals themselves, whereby they become mentally depicted like nothing so much as the incompletely developed embryos of numerous living oceanic types."

ORIGINAL COMMUNICATIONS.

Notes on the Habits of the Northern Fur Seal.

By G. E. H. Barrett-Hamilton.

Introduction.

There is probably no species of wild mammal to whose life-history so much attention has been paid as the Northern Fur Seal (*Otaria ursina*). For about a century and a half a source of wealth to large and powerful companies, it was after the first discovery of its breeding haunts by the ill-fated Vitus Bering in 1742, the object of a slaughter as indiscriminate as it was inimical to the permanent interests of those who took part in it. In later years, however, when a diminished herd plainly foreshadowed the fatal effect of this foolish destruction of valuable animals, every effort has been made to preserve the seals, and they have been for some time the objects of the most careful study on the part of the governments who own their breeding haunts, a study which culminated in the appointment of the International Commissions of 1891-93 and 1896-97.

Volumes upon volumes have been devoted to the Northern Fur Seal; of these, very many are blue-books, or government publications, a large portion of which are of too patriotic a nature to be safely relied upon by scientific men. Some other accounts of the seals, which cannot be included in the above category, have been tinged with a depth of poetical imagination obviously intended for popular rather than scientific reading, so that the Commission of 1896-97 found much to correct or supplement in our knowledge of even the most simple features of the life-history of the animal. Bearing this in mind, I think I need no excuse for putting together a brief account of the observations which I made during my visits to the rookeries. In doing so I shall entirely exclude all matter relating to the commercial or diplomatic questions at issue, and I hope my notes may be taken as a perfectly unbiassed account of what came under my own notice.

Before I go further, it may be well to state that I assume that all naturalists are acquainted with the general facts of the life-history of the

Fur Seal, so graphically described by Mr. H. W. Elliott: how the herds which spend the winter months in the warmer waters of the Pacific south of their island homes, move gradually northwards in the early part of the year, and in spring, land on the rookery shores, the females to give birth to their young, the old males to commence a jealous watch over their hardly-won harems, which they only forsake when hunger and fatigue or the valour of a rival forces them to leave their posts; how the young males, unable to face their seniors and win for themselves places on the coveted rookery beach, while away the summer in sleep and frolic on their own hauling-grounds, whence the sealers take their toll of skins; how the seals remain in the neighbourhood of the rookeries until the cold gales of autumn warn them to again depart southward. Such, in broad outline, is the natural history of the Fur Seal, and with such general matters of common knowledge I have here nothing to do. It will be my business rather to attract attention to certain of the less known features of what I may call the social life of the animal.

I assume also a knowledge of such sealing terms as bull, cow, bachelor, pup, harem, rookery, and hauling-ground. Any further technical terms which it may be found necessary to use will be explained as the occasion arises.

It must be clearly remembered, however, that my visit to the rookeries was paid at a time when the numbers of the seals had admittedly decreased since the date of the descriptions of some of the older authorities, as, for instance, those of Mr. H. W. Elliott. Hence, if what I saw does not always quite closely correspond with the observations of older naturalists, it does not necessarily follow that one or the other of us is in the wrong. It may be that both they and I are right, and that the differences which it is our duty to record actually existed and are due to the prevalence of different conditions on the rookeries at different times, consequent on their disturbance by man.

My Experience.

My personal experience of the Northern Fur Seal was gained in the two breeding-seasons of 1896 and 1897, during which I actually lived in turn on every island where there is any important rookery at the present time. On one island or another I had the seals under my observation almost throughout the duration of their summer stay on land. My movements were as follows:—In 1896 I gained my first introduction to the seals at the small rookery on Robben Island (in the Okhotsk Sea), which I examined on July 11. In the same year I spent July 19 to August 10 on Bering's Island, and August 11 to 25 on Copper Island, on the western side of the Bering's Sea. I spent September 1 to October 4 on St. Paul Island (including two days at sea among the pelagic sealers in the United States Revenue

cutter "Rush"), and October 4 to 22 on St. George Island, thus missing only the earlier part of the season of 1896. In order to complete my knowledge, and to be able to observe the seals in the earlier part of the breeding-season, I reached Bering's Island in 1897, on June 19, and remained there until August 2, when I sailed for Copper Island, and landed there on the following day. On August 19 I left Copper Island in an unsuccessful search for seal rookeries on the Kamchatkan coast, and did not again return to the seal islands. During my stay on the islands I personally examined and walked over the whole extent of all the rookeries, with the exception only of one or two of the lesser ones on the Commander Islands, which I had to be content to observe through my binoculars, either because they are inaccessible from the land side, or because I had not permission to approach them more nearly.

Enumeration of Seal Islands.

The islands whither the seals resort for breeding purposes are now all well known, and it is unlikely that the most diligent search can add to their number. They are the Commander and Pribilof Islands in Bering's Sea, certain of the more Northern Kuril Islands,[1] Robben Island (in the Sea of Okhotsk), and possibly one or two other small rocks[2] and islets in the same sea. It can hardly be doubted that the presence of the seals on these islands, apparently scattered at random throughout the North Pacific, and their absence from many others equally suitable for their purpose, such as the Aleutians, depends entirely on the former presence or absence thereon of man. The Commanders and Pribilofs are the only large uninhabited islands in the North Pacific, and there are no rookeries on the Aleutian Islands, which, although affording very suitable conditions, are inhabited throughout their extent.

What Guides the Seals in their Choice of an Island or Rookery.

A glance at Sir John Murray's map (*Geographical Journal*, August 1898) to illustrate the annual range of the surface temperature of the ocean will show that the question of temperature has had no very great influence on the choice of the seals of islands on which to bring up their young. Whereas the Pribilof and Commander Islands lie in regions where the surface temperature is cold, and has an annual variation of only 20° F., the corresponding figure for the Northern Kuril Islands is 30°, while the little rookery at Robben Island lies close to the border line of regions where the annual variation amounts to 35° and 40° F. respectively. Again, whereas in the event of a backward

[1] Shnednoi, Raikoke, and Mushir.

[2] St. Iona and the Shantai Islands.

spring the seals must await the dispersal of the ice before they can land on the colder shores of the Pribilofs and Robben Island, the ice-free Commanders are always ready to afford them a safe resting-place. It is obvious then that what they chiefly want are uninhabitable islands which are free from ice and snow by the time at which they wish to land. On such islands breeding seals are not at all particular as to the nature of the ground they lie upon, provided only that it is not a sandy beach. Such a beach seems to cause them some annoyance, probably because the particles of sand (especially in wet or windy weather) stick in their fur and irritate their eyes. The non-breeding seals or bachelors have, however, no such aversion to sandy beaches, and are frequently to be found hauling up on such, especially on the great sandy bays of St. Paul Island. In the latter case, however, it may be that they haul up on sand not because they like it, but because all other suitable areas are occupied by breeding seals, and hence forbidden ground to the bachelors.

The only rookery where I saw breeding seals hauling up on sand is that of Robben Island, and here the shingle which composes the beach becomes in some places gradually finer, so that it is actually of the consistency of coarse sand. In addition to Robben Island there are one or two sandy spots frequented by breeding seals at St. Paul's, but these are small and chiefly brought into prominence by the ravages of the parasitic worm (*Uncinaria*) among the pups born on these flat sandy surfaces.

Elsewhere the rookeries and their situations are as varied as they could well be. Thus on St. Paul Island the seals, finding flat areas gently sloping up from the sea, have overrun whole acres of the island, even ascending the sides of hills, which lie at a distance of several hundred yards from the beach, and reducing the whole area occupied by the rookeries to a bare expanse of stone and clay, long since worn quite clear of grass or vegetation by their constant passage over it. St. George Island is more mountainous, and here the seals are forced to occupy more rocky ground, only advancing up the cliff-sides where the nature of the ground permits their easy ascent. On Bering's Island one rookery is on a great reef, while the other is on a narrow beach at the foot of a low but unscaleable cliff. Lastly, we have the opposite extreme in mountainous Copper Island, where the high sheer precipices leave the seals no choice but to occupy the narrow beaches, small inaccessible bays, and projecting reefs, which alone intervene between the island and the sea. Yet even here, when opportunity offers, they climb up the gulleys formed by streams which have here and there cut a channel for themselves through the cliffs on their way to the sea, and, as at Palata, wear out for themselves a bare parade ground above the level of the shore. Naturally the best sites for rookeries are sheltered bays where projecting reefs shield the young pups from the violence of a heavy surf and form pools where they can

play and learn to swim in safety. Such bays are to be found on Copper Island at Gavarushkaya and Sikatchinskaya, while parts of the great northern rookery of Bering's Island are fairly well protected from storms. Thus on shore all sorts of ground seem suited to their wants, except, as already noticed, flat sandy areas, and beaches in the too close proximity of overhanging cliffs. Here landslips have been known to occur, burying and killing a number of the cows, as at Palata in Copper Island; while at Orilli Kamen, another Copper Island rookery, I found the skeletons of three unfortunates (one of which at least was a bull) under a great boulder which had fallen down from the cliff above the rookery and crushed them. But perhaps their most favourite haunts are cliffs where the slope is not very steep and large boulders lie plentifully strewn on the face. Here they ascend often to a height of a hundred feet or more, easily traversing places where a man could hardly climb. Such cliffs are very numerous at St. Paul Island, and here seals may be found asleep in all sorts of strange retreats on the cliff-sides, whence, if unexpectedly disturbed, they will often jump blindly down a steep incline, facing a fall that would kill a man. The little pups, too, are very fond of lying asleep with their heads, or sometimes their whole bodies in holes, under rocks. When disturbed they rush in hot haste, "baaing" lustily, in any direction in which at the time their nose happens to be turned, not looking in the least to see whither their precipitate flight will lead them.

Robben Island—Comparison of Mr. Elliott's Observations.

My first acquaintance with the Fur Seal was gained at Robben Island, and a mere glance at the little rookery there was sufficient to show that neither is the animal, as a whole, deserving of the reputation for intelligence with which Mr. W. H. Elliott has clothed it, nor is the cow the sweet-tempered, dove-like creature which the same writer has described. Not only were the bulls exceedingly active and constantly engaged in rushing blindly hither and thither, utterly regardless as to whether they trampled the cows or pups under their flippers, but the cows, although they sat huddled closely together as if in a state of affectionate good-fellowship, were constantly snapping at each other in a bad-tempered manner, and savagely resented the approach of all pups except their own. A dead pup which I picked up at some little distance from the rookery showed, on examination, that it had received a bite, probably from a cow, on the head, where the punctures made by two canine teeth were plainly visible in the thick skin. The greater part of the head was in a rotten and putrid condition as if a fatal erysipelas had set in as a result of the bite.

Variability of Seals.

A point which at once strikes a visitor to a seal rookery is the great variability in the colour and size of the animals. There are indeed limits to such variation, but within these limits the Fur Seal of almost all ages cannot but be regarded as a most variable species. The same is true also of skulls of the animal, and differences can easily be found in specimens from the same rookery such as would, if they were constant and each confined to specimens from particular localities, undoubtedly warrant their division into several distinct species.

Observations on the Rookery.

It was one of my objects to observe the first landing of the seals on the islands, in order, if possible, to test for myself the trustworthiness of Mr. Elliott's wonderfully graphic description of their habits at this season. Accordingly I endeavoured to reach the islands at as early a date as possible in 1897, and actually arrived at the North rookery of Bering's Island on June 20, or very soon after the appearance of the first seals. I then visited the South rookery of the same island, and pitched my tent there on June 23, with the intention of remaining for at least a week. Finding, however, that the state of things at the South rookery was not exactly what I needed for the study of the seals, I left it on June 26, proceeding by dog-sledge to the North rookery, where I arrived on June 29. Here I remained four days, during which almost my whole time was spent in watching the seals, chiefly at the part of the rookery known as Kishotchnaya. I was informed that there had been present on June 16, 13 bulls, 110 cows, 37 pups, and 5 bachelors. On June 20 I found the 13 bulls thus disposed:—

5 with a mass of at least 175 cows and a number of newly-born pups.
1 with 6 cows and 3 pups.
2 with 2 cows each.
1 with 1 cow.
1 lying asleep near the bachelors.
2 alone to the south of the main patch of cows.
1 alone in another position near the main patch of cows.

At this date I take it that the rookery showed the condition in miniature which a well-regulated rookery, of whatever size, should show at the height of the season—that is to say, there were a certain number of strong bulls which had appropriated to themselves large harems, in this case averaging over thirty-five females each: there were

other bulls who had to be content with harems containing from one to six females each, while there were yet again other bulls which were as yet unable to get among the breeding females at all, and which represented the "idle" or "reserve" bulls of the Pribilof Islands.

Several points struck me in connection with the habits and disposition of the bulls during the earlier parts of the season:—There were at the North rookery no bulls anxiously awaiting the arrival of the cows on the shore-line. The best stations were evidently not on the shore-line, but at the places where the patches of first-arriving cows were massed together, and it was to these patches and not to the sea that the attention of the still unoccupied bulls was directed. Many of the bulls, both of those which possessed harems and those which did not, were asleep, and were not displaying that almost ceaseless activity which a perusal of the writings of Mr. H. W. Elliott would lead one to expect.

The cows were not received by the bulls at the shore-line, but seemed to come in unnoticed and quietly joined one or other of the patches of their sisters who had already arrived. Sometimes a cow was delayed in her progress up the beach by the unwelcome attentions of one or other of the wandering half-bulls which had not yet gained a harem, but such delay was seldom of long duration, as the cows were very persistent in their movements and resented as angrily as they dared all attempts of the half-bulls to stop them.

The rookery in its first beginnings did not consist of a large area of loosely scattered bulls and cows, but of the above described densely crowded, although small, patches. It is thus interesting to note the passage by a large rookery early in the season, although in the reverse order, through the stages exhibited by one which is in the course of being exterminated. The former starts as a number of detached and crowded patches, which in the end coalesce and fuse to form one rookery; the latter musters in the early part of the season in exactly the same manner, but the patches may never grow large enough to coalesce and fuse. In spite of the crowded condition of these patches, the cows were, as at Robben Island, constantly quarrelling with and snapping at each other. The bachelors, no doubt owing to the great proportion of old and unoccupied bulls present, were hauled up in one lot by themselves, and amongst them were several of the large half-bulls, which later in the season were acting as masters of harems on the breeding-grounds.

The bachelors appeared to be ready to stampede had they been approached too closely, but the bulls and cows could not, I think, have been moved except by force. The bulls roared at us and were very threatening, but would not leave their cows to attack us. All the bulls appeared to be in good health, but in a variable state of fatness.

As the season advanced and the area of ground occupied by the rookery increased, it was obvious that the small harems seen by me on June 20 were merely the nuclei of larger gatherings, which gradually increased and swelled so much as to coalesce and form the rookery as seen in its completed aspect. Thus those bulls which were at first obliged to sit outside the harems were for the most part absorbed in the breeding-grounds, and, as at the Reef section of the rookery, the bachelors found no difficulty whatever in wandering among the cows.

By the 29th June the females had so increased in numbers as to be quite out of the control of the bulls, and they were then able to make their way to or from the sea with little or no interruption. Many of them lay in loosely scattered patches with no bull to attend on them.

Yet the strange thing was that, although in several cases the harems of individual bulls grew to such unwieldy proportions that the bulls were powerless to prevent the cows from leaving them or from joining other bulls, there were all the time other bulls which, either from the position which they had selected or from other reasons, were never able to secure a harem. Their desire was evidently to occupy some particular position already commanded by a stronger bull. This being impossible, they sat or slept out of reach of their enemy, and made no attempt, as a rule, to collect a harem for themselves.

Occasionally, however, one of these solitary bulls would become infuriated, and, charging down upon the harems, would seize a female and run away with her. The female, however, thus captured invariably, as far as I could see, returned to her old place at the first opportunity.

Although not possessing harems, these bulls were by no means idle, for they often had a single cow with them, which no doubt had been dissatisfied with her treatment at the hands of the master of her own particular harem, and had sought another lord. The visits of such cows to these outlying bulls appeared to be of a merely temporary nature, and I think they returned to their own harem when satisfied by the accomplishment of their object in leaving it.

Some of the harems which I kept under close observation for several days will illustrate these points.

There were at the south end of Kishotchnaya during the early part of the season four bulls by themselves; one of these had on the 29th June about sixty-three females and another twenty; while not far from them sat three younger bulls, one alone and the other two with three females.

The following table shows the increase in the two larger harems from day to day:—

	June 29.		June 30.			July 1.	July 2.	July 3.
	P.M. 2.30	P.M. 6.15	A.M. 10.40	P.M. 3.15	P.M. 6.30	A.M. 10.35	A.M. 11.55	P.M. 12.10
Harem I., number of cows .	63	64	56	63	64	90	69	89
Harem II., ,, ,, .	20	24	24	24	34	42	52	72
Total number of cows in the two harems . . .	83	88	80	87	98	132	121	161

Now, although these harems thus increased from day to day, so that in four days the number of cows was about doubled, and the cows, being in the proportion of (on the 3rd July) eighty to the bull, were completely out of control and free to move about as they wished, yet during all that time there were bulls hovering round the outskirts of the harems, some of which were masters of no cows, and none of which had succeeded in collecting a greater number than three each. Nothing could better illustrate the fact that it is the cows, and not the bulls, which have the real control of the harem-system. Over these 161 cows the bulls, in spite of all their bluster, had the flimsiest of nominal dominion, and the cows were always able to, and frequently did, leave their harems to dally with cowless bulls on the outside. Yet, whether their number was 80 or 160, as long as they chose to sit massed together on the ground which had been appropriated by the two stronger bulls, no weaker rivals could approach to within a distance of 10 yards from them. The master of the harem had no control over its occupants, but he was absolute lord of the ground on which they sat.

An almost better illustration of this was to be seen at the South rookery, where, later in the season, there were often 200 cows on shore with two bulls. Yet (as on the 26th July, when there were 287 cows on the beach) the division of the cows into harems was a very unequal one, the smaller bull being only able to keep a very few cows, while the larger one claimed the greater part of the rookery. But the cows could pass over to the smaller bull's ground as often as they liked, and he probably was father to a great many more of the pups born in 1898 than those of the half-dozen cows over whom he claimed control.

At the same rookery on the 28th July, when there were over 190 cows on shore, the whole of this number was greedily claimed by the larger bull, while the smaller bull was forced to sit apart outside the patch of massed pups which lay just outside the rookery. True he sometimes threatened to make descents on his rival's harem, but he had no cows that he could really call his own until they themselves took the initiative and went out to join him.

Thus the inequality of the two harems at the North rookery kept increasing until there came a time when the newly-arriving cows began

to lie in scattered groups outside the main mass, and thus permitted the weaker bulls to form new harems out of the reach of the two strong old bulls.

The following table shows the number of bulls and cows on the western portion of Kishotchnaya outside of the two larger harems:—

	June. 29		June 30.			July 1.	July 2.	July 3.
	P.M. 2.30	P.M. 6.15	A.M. 10.40	P.M. 3.15	P.M. 6.30	A.M. 10.35	A.M. 11.55	P.M. 12.10
Total number of cows in the two larger harems (as before)	83	88	80	87	98	132	121	161
Number of other bulls in this section	4	4	...	...	3	4	3	?
Number of outlying cows .	1	5	...	...	1	3	16	18

A fact which came under my observation in connection with the bulls and half-bulls was the fact that several of those which had a regular station on the rookery occasionally absented themselves from it. Thus, one bull at Kishotchnaya was absent from his place during the earlier part of the 1st July. In the evening I was fortunate enough to see him return. At 1.20 P.M. on the 2nd July this same bull—a grey one, and therefore probably of no great age—left his place in the rookery, and passed out to a position less than 100 yards away on the reef. Here he slept until 3.20 P.M., when he awoke, deliberately returned to his place on the rookery, and scattered the other bulls who attempted to face him.

In 1896, too, I had observed the same phenomena. Thus on July 23, whilst some of the isolated patches of seals at the section of the North rookery known as the Reef were under my observation, I saw a very black-looking bull coming across the sands towards the rookery from the west, and apparently from the sea. When this bull approached the rookery more closely several of the others began to make demonstrations against him, rushing out for some distance from their harems to meet him. At first the intruder seemed to be frightened by the show of hostility with which his arrival was greeted, and slackening his pace, sat down as if to rest and think things over before approaching within fighting distance. Thus I got a snap-shot of him. He was, however, only taking his own time about his own business, and presently he went deliberately into what he evidently considered his own place, the other bulls retiring before him. From the first his action was deliberate, and he made for one particular part of the rookery as if he had known it all his life. These roving habits on the part of a full-grown rookery bull were so unlike anything of which I had read previously, that they gave me a good deal of trouble before an explanation was forthcoming. At first I was inclined to attribute them to possible disturbances of the rookery during the

course of driving the seals, by which this bull had been driven into the sea (as I have seen many others during the course of a drive on the very same ground), and had not returned for some hours. But later in the season on the Pribilofs, on the little undisturbed rookery of Ardiguen, there was under the observation of our whole party a bull who, after having held his own place valiantly before all comers throughout the season, at length retired to the sea for rest and food. But to our surprise we saw him returning fat and sleek after a few days' absence, and during the rest of my stay on the island he continued his assiduous attentions to his now attenuated harem, varied only by occasional visits to the sea. It appears, then, that there is a good deal more latitude and deviation from their habits on the part of bulls than one would have supposed from reading the earlier accounts, and there can be no question that some of the bulls which frequent the rookeries of the Commander Islands come and go to and from the sea and their harems even at the height of the breeding-season, but that others (as noticed at the Pribilof Islands) only assume these wandering habits at or near the close of that period. I never saw a bull that I was certain was a really old one behave in this irregular fashion, and the old yellow-looking bulls of the central massed portions of the rookery never left their places even for an instant, so far as I could see. It may be, therefore, that the irregularity occurs only among the younger bulls, and is due to the system of management of the rookeries, whereby the number of spare bulls has been diminished, so that young animals have no difficulty in gaining harems for themselves at an age when their strength would certainly have been insufficient to have enabled them to do so in a state of nature. At all events, such wandering habits are normally those of the larger bachelors and half-bulls, who, when unable to gain access to the harems, pass a restless life on their outskirts, varied with occasional—in the case of the younger animals frequent—visits to the sea. To these habits the two bulls of the little South rookery of Bering's Island reverted at the end of July (1897), first becoming restless and moving about a good deal before they left the rookery for good.

On the 13th July, on which date the North rookery was visited by Dr. Stejneger, Professor D'Arcy W. Thompson, and others, it was found that there had been a marked increase in the number of the seals, both in the case of the females and, what struck me more, in that of the bulls. The western section, which had never contained more than six bulls and 179 cows on any previous occasion on which we had visited it, now included a number of cows which was variously estimated at from 500 to 700 individuals. With these, from seven to ten bulls were noticed by the various observers. The area occupied by the seals had greatly increased, and the harems which had been previously under observation were now indistinguishable ; the places of the two bulls were, however, occupied, if not by the same animals, by similar or identical

ones. All around their stations were new harems, which had been formed by late arriving cows, attended on by bulls which had previously possessed only a few cows each.

At the Reef or eastern section a very similar state of things prevailed, and on the 13th July not only was the number of cows on shore vastly greater than on any previous occasion in that year, but the bulls had also increased in numbers in a manner for which, I confess, I was totally unprepared.

A point which struck me very forcibly in regard to the new bulls on this day was that they were, in my opinion, all young bulls, that is, they were blacker or greyer, as well as smaller, than the bulls which I saw during my earlier visits to the rookery, in the centre of the thickest masses of females.

The new bulls did not show the yellowish colour of the older bulls; they did not accompany the old bulls to the rookery early in the season when they arrived to await the coming of the cows; and they would not at that time have dared to approach within many yards of these old bulls. It was evident, in fact, that, like the cows and bachelors, these young bulls continue to arrive at the rookery until the height of the season, and that they do not accompany the older bulls, which arrive before and await the arrival of the cows.

I am unable to state the time at which the old bulls left the North rookery of Bering's Island, for in 1896 I was not there early enough to recognise them individually, and it was unfortunate that in 1897 neither Dr. Stejneger nor I were able to visit the North rookery after the 16th July, on which date I could recognise many of the bulls which I had seen on the rookery ground earlier in the season. At what time they took their departure it is impossible to say, but it seems reasonable to suppose that they did so at the same time as did the bulls of Copper Island, that is to say, at about the first week of August.

Behaviour of the Bulls.

The following notes will give some idea of the nature of the tasks which the bulls have to perform:—

At Kishotchnaya, in the harems which I kept specially under observation, a large half-bull was observed *in coitu* at 3 P.M. on the 29th June. Afterwards the cow and bull did not separate, but continued to sit near each other, and at 3.55 P.M. the act of copulation was repeated, on this occasion in from 6 to 8 inches of water. I then left the rookery, and returned at 6.15 P.M., at which time I found (apparently) the same animals for the third time *in coitu*, on this occasion in water in which both could swim; the operation took place largely when the animals were floating side by side in the water.

At about the same time (viz. 6.40 to 6.55 P.M.) another half-bull and cow were observed *in coitu* in a depth of from 2 to 3 feet of

water. On its termination the animals swam away in different directions.

On the 30th June the bull whose harem is numbered II. in the table on p. 25, was observed *in coitu* twice during the space of about one hour, the first time at about 6.34 P.M. He was afterwards active until about 7.33 P.M., when he again performed the act.

On the 1st July the same bull was observed *in coitu* twice during a period of six hours, that is to say, at 12.9 P.M. to 12.14 P.M., and again at 12.33 P.M. until 12.41½ P.M.

On the 2nd July he was observed *in coitu* four times during a period of four hours, viz. at 12.35 P.M. until 12.37½ P.M., at 1.30 P.M. until 1.35½ P.M., at 2.5 P.M. until 2.12 P.M. (in the latter case apparently futilely), and at 3.31 P.M. to 3.39½ P.M.

During a period of thirteen hours, in which on various occasions the two bulls were under observation, each was observed *in coitu* eight times.

If each bull kept up the same rate during a whole month of twenty-eight days, it is obvious that he could accommodate a harem of over 200 cows. The rate is, however, as shown by the above notes, not constant, and it happened that the periods of greatest activity of the two animals did not always coincide. This I put down to the varied times at which the cows came into heat, and from the notes which I was able to make it seems nearly certain that the cows are covered more than once each. The action of bull 1 during six hours, in which he was observed *in coitu* no less than six times, led me to believe that, in the case of several at least of the acts which I then observed, it was the same cow which was covered; but of this I cannot be certain, it being extremely difficult to keep any one cow under observation in a crowded harem.

On the South rookery of Bering's Island the two bulls are known to have been present from about the 5th July to the 1st August, a period of only about twenty-six days. Their departure at about the latter date may be assumed to have been due to either of two facts—viz. either there were then no females requiring their services, or else their power of accommodating the females was finished for the season. That the latter was the true reason seems almost certain, from the fact that there was a newly-born pup with its mother—probably a three-year-old cow with her first pup—on the rookery beach when I visited it on the 2nd August, and also from the fact that it is in the last week in July or the first week in August that the large old bulls of the Copper Island rookeries leave their harems and retire to the beaches north and south of the breeding-grounds and elsewhere.

We know that these two bulls at the South rookery had between them a lot of at least 530 cows, or 265 cows each. If each of these cows were covered only once during the twenty-six days, it would be necessary for each bull to satisfy about ten cows every twenty-four

hours throughout his season, and a very much greater number if any large proportion of the cows received a second service.

On this rookery there appears to have been only one bachelor large enough to assist the bulls, but he was not larger than a big cow, and does not seem to have exerted himself much: only on one occasion was the presence of three bulls (the third being probably the large bachelor) reported by the natives.

These two South rookery bulls were neither of them apparently very old: but one of them was a pretty large dark bull, with a light wig; the other, a smaller bull, was, as has already been stated, only permitted by his rival to remain at or near the edge of the rookery.

On the 24th July both these bulls appeared to be active, and each was observed *in coitu* at 3 P.M.

On the 25th July the smaller bull was noted to be looking thin, and was seen *in coitu* at 11.30 A.M. He seemed to spend most of his time in sleep, whereas the larger bull was more active, and constantly examined his harem as if to find a cow in heat.

On the 28th July, at 3 A.M., Mr. Volokitin (the Russian in charge of the rookery) noticed only one bull on the rookery.

By the 29th July the two bulls had begun to go into the water and to follow the females to the outlying rocks on the reef, and on the 30th, when I examined the rookery at 8.30 A.M., there were no adult seals on shore, and no bulls to be seen anywhere. Mr. Volokitin told me that one bull was on the beach on the 1st August, but there were none to be seen when I visited it on the 2nd August.

If the bulls were vigorous, the bachelors, down to the smallest of them, were equally so. In the earlier part of the season no bachelors were observed at the South rookery, but at the North rookery, as I have already said, I found them, when I first arrived there, lying in a pod by themselves apart from the breeding seals. As the season approached its height, and the number of cows so increased and spread over the ground as to render the task of the bulls who tried to restrain their movements a hopeless one, the bachelors began to mix amongst the females and to wander about among them much as they pleased. It was at this time that I was able to satisfy myself of the correctness of the observations, often described, of those who have seen the young bachelors covering the cows.

My attention was first drawn to this at 4.35 P.M. on the 30th June, by hearing the strange voice of a bachelor, neither quite like a cow nor quite like a bull, at the Reef section of the North rookery. I found that this proceeded from a small bachelor who was trying to cover a female, obviously in heat. Another and smaller bachelor also tried to cover the female, and then a bigger one coming by drove the small one away, and amused himself with the female until 5.3 P.M. She then escaped from him, being evidently satisfied, but he pursued her and

tried to prevent her leaving, in exactly the same manner as a mature bull would have done. These proceedings went on in water, in which both animals were practically afloat, and occurred at the edge of the patch of seals lying nearest to the land, and not far from the large bulls. The female was obviously in heat, since she allowed the bachelors to play with her. Several other small bachelors were constantly loitering about while the larger one was *in coitu*.

On the same day I saw another quite small bachelor trying to mount a female at another part of the same rookery, but she seemed to object, and a bull eventually drove him off. Later on I saw the bachelor in the shallow water annoying other females.

Such occurrences I afterwards saw frequently, the bachelors being in some cases actually smaller than the cow they attempted to cover, and only recognisable by their voice and for other reasons. In all such cases the bachelors behaved exactly as would have a large bull under the same circumstances, trying to keep the cows close to them in order to be able to cover them again. In some cases I saw cows which were certainly in heat escape from bachelors and pass right under the bull's nose without being covered, the bull's attention being too much taken up with other cows to notice them.

The same thing went on also at Kishotchnaya, where I first noticed it also on the 30th June. On the 2nd July I watched the harems of the two large bulls at Kishotchnaya (already alluded to) continuously from 11.55 A.M. to 4.8 P.M., and during this time the bull numbered I. was observed *in coitu* twice and the bull numbered II. four times. Yet during a good part of that time a young and quite small bachelor was among the fifty-two odd cows of which the latter bull's harem was on that day composed. At 1.26½ P.M. this young bachelor was covering one of the cows, my attention being attracted to the fact, as on the previous days, by the peculiar voice of the bachelor. The affectionate way in which the cow treated the bachelor made it certain that she was in heat, yet although the bull came up close to them, and even "nosed" the bachelor, the latter's presence and actions did not seem to arouse his suspicions, and the bull paid no other attention whatever to him. Presently the cow left the bachelor, and at 1.30 P.M. the bull covered her himself, finishing at 1.35½ P.M. Meanwhile the little bachelor was in a state of great excitement and displayed a very great deal of interest in the proceedings, several times jumping up on the side of the bull. The bull, however, as before, paid absolutely no attention to him. At 2.5 P.M. this bull was again seen *in coitu*, and meanwhile another cow "nosed" him a little. At 2.13 P.M. this latter cow was mounted by apparently the same young bachelor right under the bull's nose. The bull paid no attention whatever to this poaching in his harem, but moved to the other end of his domain, while the little bachelor went on riding the cow until 2.21 P.M. The behaviour of the cow to the bachelor

showed that she was evidently in heat; the cow and bachelor were of about the same size.

The extraordinary thing about it all is that this bull (and so, too, in the case of other bulls) had no objection whatsoever to allowing young bachelors to enter his harem and cover his cows. Had, however, one of the large outlying half-bulls approached the harem, or even moved about in its neighbourhood, the bull would have been very excited, and would have roared incessantly, and have gone out to attack the half-bull. The mere sight of copulation, however, going on near a bull does not excite his interest in the least so long as it does not occur in ground which he claims for his own.

At the South rookery I did not see anything of this sort going on, and the larger of the two bulls was much more careful in keeping the bachelors out. All of the latter that I saw were, however, with one exception, very small ones, and mixed with the cows at the southern edge of the rookery.

It is thus evident that the sexual feelings of even the smallest bachelors are very strongly developed, and I can thoroughly indorse the remarks of Mr. F. W. True on this subject (see his Report for 1895). Even the small male pups have the testes in a very forward state of development, and by the 29th July, at the South rookery, I saw the little black pups acting to each other in a way that made it certain that their sexual feelings had already made themselves felt.

With regard to the mutual relationship of males and females, there is little to be said that has not been already included under some other heading in this article. That the cows are as little "dove-like" in their dealing with the bulls as with their own sex, I am able to state from personal observation, and I have seen an offended female bite a bull savagely and then leave him and go to another harem. For a short time, however, during the breeding-season, a feeling which almost appears to amount to affection exists between bull and cow, and is best observed in the cases where a single bull and cow are to be found sitting by themselves. They are then for a short time inseparable, but after the sexual feeling has been satisfied they become as snappish to each other as before. Such pairs of breeding animals are more frequently to be observed at the end of the season, when the older seals have left the rookeries and the young bulls and cows come on to the breeding-ground. The harems are then small, and frequently consist of one cow only.

I have already quoted observations tending to show that the animals do not separate until copulation has taken place more than once. A young bull and cow noted at Zapadnie rookery on the 7th August were still together and inseparable on the 9th. As the season goes on, the cows forsake the beach in constantly increasing numbers for the water in its neighbourhood, while the bulls retire to sandy or shingly beaches, where they can haul up free from domestic worries.

The rookery-ground is then largely occupied by pups and young breeding animals of both sexes.

The following detailed observations made on the South rookery will, I think, be found of interest. It is of course impossible to give a complete set of continuous observations for the whole season, since there were other rookeries to be visited, entailing long and often tedious journeys, in which I was greatly dependent upon wind and weather. Thus, on one occasion, it took Dr. and Mrs. Stejneger and myself six days to make the journey of 21 miles by sea to the South rookery from Nikolski, and during five of these days we were camped on the beach under our boat waiting for favourable weather. My notes have, however, been supplemented in many cases by observations made on other rookeries, especially on the Kishotchnaya section of the North rookery, where I spent several days (29th June to 3rd July) in close observation of the seals.

My first visit to the South rookery began late on the 23rd June and ended on the 26th June. There were then no bulls at the rookery and no bachelors. On the morning of the 24th there were sixteen females on shore, and their number was shortly afterwards increased by the arrival of three more from the sea, making nineteen in all on the beach. With these were eleven pups, and there was in addition a small lot of about fifteen seals playing in the surf outside the rookery. During my stay at the rookery the number of seals rapidly increased from 41 to 89.

The females at the South rookery might at this time have been divided into three classes, that is, those who were on shore, the majority of whom had pupped or were about to do so very shortly, those who spent their time in the surf outside the rookery, and a very small number of females who belonged neither to one nor the other of the above classes, but were engaged in reconnoitring the beach with a view to shortly landing. The members of this last class frequently landed for a short time and then went into the sea again.

It was very evident that the numbers of the females in the surf, as well as of those on the beach, were constantly being added to, chiefly during the night. When a female arrived first she appeared to join the ranks of those playing in the surf. With them she remained for an unknown period, and then came in to reconnoitre the rookery, probably landing several times in a temporary manner before finally doing so for the purpose of pupping. Probably, however, had there been a number of bulls on the rookery, such females, having once thus landed, would not have been allowed to leave again so easily.

Mothers and Pups.

The females on shore, certainly those who had pupped, seemed to move about very little, and my observations of them lead me to believe that they do not leave their pups for quite a considerable time

after they have been born. Each female who has a pup lies quite close to it for some days. If she moves her position she carries the pup with her, usually holding it by the back of the neck, but sometimes lower down the back. If the pup moves from her it is caught and pulled back to its mother's side. It is no wonder then, after such a close association between mother and pup in the earlier part of the season, if later on they can, and do, recognise each other among the multitudes of seals occupying a rookery.

On one occasion (26th June, at the South rookery) I saw a cow who had quarrelled with another cow, and had been defeated, retire out of the pod of massed seals carrying her pup with her, holding it by its back near the tail. Another cow seized the pup by its neck, and a tug-of-war ensued before the mother got off with it. Finally, before she got quite clear another cow carefully smelt the pup, evidently with a view to be sure that it was not her own. On another occasion (at Kishotchnaya, on the 2nd July) I felt almost sure that a cow whom I saw moving her pup did so in order to save it from the ponderous tramplings of a bull.

The little new-born pups are the source of constant squabbling among their mothers, and any attempt at familiarity on the part of a stranger is at once resented in the most savage manner.

Few points are, indeed, more striking in the character of the Fur Seal than the spirit of inconsistency which causes the cows to lie so closely huddled together on the beach that one of them can hardly move without disturbing two or three of her neighbours, and all, one would think, must be imbued with the most friendly and sociable dispositions; yet the slightest stir or familiarity on the part of a neighbour is resented with a fierce snap, and if a pup ventures to approach a strange female in mistake for its mother it is at once seized, savagely shaken, and thrown away—even killed—much as a terrier treats a rat. Yet Mr. H. W. Elliott has devoted some space to a description of the meek and dove-like character of these female seals!

Not only is any familiarity on the part of their own species resented, but I have seen a female hold a regular sparring match with a glaucous-winged gull (*Larus glaucescens*, Naum.) who wished to make a meal off some recent placenta, and the little blue foxes which sat as close to the seals as they dared were constantly being chased away if they ventured to approach a little too close to the rookery. Sometimes they pay for their impudence with their lives, and I have several times seen a blue fox chased away by a cow who thought it had approached too near to the rookery. In 1896, I found at Zapadni, Copper Island, the carcase of a young blue fox which had evidently been recently killed by some cow or bachelor, whose seeming meekness it had trusted too much, and had received in return a fatal bite in the neck.

The newly-arriving females were treated with equal want of courtesy. Their desire always seemed to get right into the middle of

the mass of seals already on shore, but whenever a new-comer approached the edge of a rookery she was received with such a series of snaps that in one case at least I saw a female go right round the mass two or three times before she could get in. When such a seal has at last got into the rookery her progress to a resting-place is one constant series of fights, as she scrambles over the backs of her sleeping sisters, and finds her course disputed by each one in her way.

At this early part of the season the number of cows on shore did not seem to be appreciably affected by the weather, and I do not believe they will under any circumstances leave their newly-born pups.

So too at Kishotchnaya from the 29th June to the 3rd of July the cows were constantly arriving in large numbers, yet during that time there was never any great number of them in the sea, only about enough, in fact, to account for the newly-arrived females. I do not wish to say that the cows never left their pups, but I am certain that very few did so, and the number going to sea was always very much less than that of those coming from the water. At this time they have little or no fear even of a man, and can be approached and photographed at any near range. Those cows who pup late in the season stick equally close to their pups, and I found a young cow at Palata on the 9th August who stood up to me as boldly as a bull, and allowed me to photograph her and her pup at a distance of only a few feet.

Exactly how long the cows stay thus on shore after they have pupped it is in the present state of our knowledge impossible to say, but a small amount of light is thrown upon the question by the movements of one of the South rookery cows, whose back was marked with flesh-coloured spots in such a manner that she was always easily recognisable. This cow hardly moved her position during the three days of my first visit to the rookery:—

24th June,	morning	First seen.
24th „	6 P.M.	Asleep with pup in same place.
25th „	morning	Asleep a yard or two from former position.
25th „	6 P.M.	Asleep with pup in same place.
26th „	morning	Still asleep in much the same place.
24th July	... .	Not noted.
25th „	3 to 4.15 P.M. . .	Asleep near same position.
26th „	... .	Not noted.
27th „	morning	Asleep near old position.
27th „	about 3.30 P.M. . .	Went away with some stampeded seals.
28th „	morning	Absent.
28th „	6.15 P.M. . . .	Again ashore near old position.
29th „	10.8 A.M. . . .	Asleep with other cows on rock to south of rookery.
29th „	12.15 P.M. . . .	Asleep on small rock near rookery.
29th „	3 P.M.	Asleep on rookery near old place.
29th „	6 P.M.	Ditto.
30th „	... .	Not seen.
2nd August	... .	Ditto.

Probably the cows do not leave their pups until the latter are capable of moving about by themselves, and refuse to be controlled by their mothers. The young pups grow with great rapidity. At first they are very weak and feeble-looking, but they seem to feed a good deal during the first few days of their life, and already, on the 26th June at the South rookery, there was a distinct difference visible between the pups which had seen a week or ten days of life and the little thin new-born ones. By the 30th June, at the North rookery, a few of the little pups were independent enough to begin to collect together in little pods, and on the previous day I had seen one swimming in the shallow water on Kishotchnaya reef. A fortnight later, on the 13th July, the pups lay outside the harems of the reef in black patches, giving the rookery quite a new appearance, and causing its outline to look very irregular.

I think these little podding pups may fairly be taken as an indication of the time each mother stays on shore with her pup after its birth, as well as an index to the number of females on shore. I do not think any female left her pup until about the 29th June, and that it was not until ten or twelve days later that any appreciable number of them did so. I believe also that for some days after the female has thus parted from her pup for the first time she does not go to any distance from the rookery, but contents herself with short excursions to the outlying rocks, reefs, or kelp-patches, where she washes or plays away the hours, and probably also feeds. This is borne out by my observations both at Kishotchnaya and the Reef as well as at the South rookery.

At the latter rookery (from July 24 to 30, 1897) we could always account for so many seals that it is extremely unlikely that any great number of them travelled to a distance from the rookery in search of food. Yet that they *were* feeding I know for a fact, having on more than one occasion seen them spewing up undigested portions of their meals while on shore. Taking this fact into consideration, as well as the fact that seals are usually to be observed by vessels coasting between Nikoski to the south-west of Copper Island, when at a distance of from 3 to 10 miles from the shore, and that in that region fish are abundant, as evidenced by the abundance of birds, I believe that the nursing Fur Seal mother gets her food for some little time after the birth of her pup at no great distance from the shore, and only lengthens her excursions as the pup grows older.

In the end, however, when at last she does leave her pup to travel to the distant feeding-grounds at sea, she remains there so long, either sleeping or playing, that when she returns to the rookery her udder is distended with milk and her stomach empty.

On these occasions the seal-mother very often finds a little ravenous and half-starved pup noisily awaiting her arrival and eagerly demanding his dinner from all the other mothers he meets. These, one and

all, snap at him with great severity, and so he goes on until his own mother, landing on the beach, at once commences "baaing" for him, and the pup, if he is within hearing, recognises her voice and answers the call, and the meeting of mother and child is obviously one of mutual recognition and great pleasure. Sometimes, however, the foolish pups stray away to other ground, where their mothers have great difficulty in finding them, or perhaps do not find them at all, and, as no other mother will take pity on them and feed them, their little starved carcases, pressed flat by the flippers of their comrades, sadden the eyes of the visitor to the rookery.

Food.

It is a strange thing that scarcely anything can be found in the stomachs of the seals on shore, whether males, females, or any but the youngest pups. The reason seems to be a twofold one, namely that the seals commonly feed at such a great distance from the rookery that their stomachs are empty by the time they return to shore, and secondly, that, even if they feed at no great distance from the rookery, they seem to prefer to sleep off the effect of a heavy meal on the surface of the water, which they find no doubt a far softer and pleasanter bed than the hard rocks on shore. Thus even the older pups, if killed on shore, are usually found to have empty stomachs, and to get one with a full stomach a search must be made among those asleep in the water off the rookery.

The habit of feeding far out at sea is adhered to with strange persistence by the fur seals, insomuch so that the pelagic sealers have found them plentiful at sea in August off the Commander Islands, in localities distant from 100 to nearly 200 miles from the rookeries. Yet, except in the immediate vicinity of the rookery beaches themselves, seals are rarely to be seen in the neighbourhood of the islands, except perhaps in one or two favoured localities where fish seem to be abundant. At the Saranna river, which enters the sea at a distance of about seven miles from the north rookery of Bering's Island, great numbers of salmon are caught annually, yet it is said that the seals never interfere with the salmon and are never seen in the neighbourhood of the river's mouth.

It is not, however, an invariable rule that seals killed on shore have empty stomachs, for on 5th August 1896, while examining the bodies of some bachelors which lay on the killing-ground and had been killed during the course of a drive on the previous day, I opened seven stomachs, of which one alone was empty, the remainder being more or less full of a pink soup-like and nauseous-smelling liquid, in which were many eyes and a few beaks of squid, also a few strips of white flesh, either of fish or squid. One stomach contained a bit of salmon, and there were pieces of what looked like seaweed in others;

but it was difficult to tell exactly, as the contents of the stomachs were somewhat decomposed. This observation is of interest in view of the statement by Dr. Stejneger (Report p. 69) that he "was informed that once on the South rookery a flock of bachelors was so full of octopods that they vomited up quantities of these mollusks while being driven."

On the whole, however, the stomachs are almost empty, containing only a little mucus, bile, a pebble or two, some parasitic worms, and, perhaps, some fish bones or beaks of squid. These, the remnants of the last meal devoured by the animal, are usually regurgitated on the rookery grounds, whence a collection of fish bones may be made such as will give a clue to the food of the seals, and in which the Pacific pollak was found, as on the Pribilof Islands, to play an important part. At sea the contents of the stomachs are very different, and Mr. Lucas and I found many full ones (12 out of 26 examined) when cruising on the U.S. Revenue cutter "Rush" among the pelagic sealers in Bering's Sea. On this occasion I thought I noticed a connection between the full stomachs and the empty milk-glands, and empty stomachs (or those containing only a few fish bones) and full milk-glands, seeming to show that the mother-seals go to the sea with their milk-glands quite empty and then eat largely and sleep until their milk-glands are again full, which occurs about the time that their meal has been digested.

Not only do the seals cast up fish bones on the rookeries but deposit there parasitic worms and excrement and urine in great quantities, so that the rookeries are by no means pleasant places to tramp over: the rocks are often slippery and the odour always characteristic. Add to which the fact that on the Commander Islands at least the seals are infested by great quantities of a small dark fly, and it may well be imagined that it is often pleasanter to look at the seals from a distance than to walk among them.

I think it is to the urine that must be attributed the growth of yellow grass (*Poa* sp. ?) which first appears on ground formerly occupied by seals but deserted by them. Such grass had to me very much the appearance of that which springs up on the bare places where rabbits have been feeding on a lawn.

Summary of Statistical Results.

My statistical results show the following:—Assuming that the total number of pups on the South rookery from the 24th to 30th July was 530, that there was no appreciable increase in their number in that time, and that there were no pupless females on the rookery, then there were on the beach during a series of twenty observations a number of females which varied from less than 1 to over 59 per cent of the whole, and which was, within those limits, exceedingly variable,

the average number on shore at any one time being about 24 per cent, and the consequent average number of absentees from the beach about 76 per cent.

An almost equally variable number of females, whose minimum was about 17 and maximum about 68, with an average of over 37 per cent, was always to be found on the reef or on the rocks close to the rookery. As the pups also frequented these rocks in numbers, except at high tide, and were there met and suckled by their mothers, I am of opinion that these seals may be regarded as also having been on the rookery beach, and that the two lots together must be regarded as equivalent to the counts of seals made at any rookery (and there are many such on the Pribilofs) where the beach is not protected by outlying reefs or rocks. In other words, it seems that the percentage to be added to the number of seals on shore, in order to account for the total number belonging to the rookery, must be different according as the rookeries are protected or not. In the former case it would be much more than in the latter.

Adding the number of seals found on the beach to those on the reef and neighbouring rocks, it is seen that, although the items are so variable themselves, the total is more constant, never falling below about 26 per cent, or rising above about 85 per cent, and with a pretty constant average of about 62 per cent. In other words, the variability of the numbers of seals on shore or on the reef was due to the movement of the seals from one locality to another, and not to their departure from the rookery.

Besides this average of about 62 per cent of seals which were never absent from the vicinity of the rookery, and the numbers of which were ascertained in all cases by actual count, there was a further number who were never far away and always in sight. The numbers of these could only in a few cases be obtained by actual count, and must be, therefore, regarded as estimated only. The figures are, however, as likely to be under as over the mark. The numbers of these seals were also variable, falling once to nearly 2 per cent, and rising to above 62 per cent, and having an average of about 21 per cent.

Combining these figures, I find that there was no occasion on which I could not account for over 65 per cent of the total number of cows, that on one occasion I could account for over 90 per cent of them, but that these figures must be regarded as extremes, the average number of cows accountable for during a series of sixteen observations being about 83 per cent, and the average percentage of absentees being, consequently, about 17.

There would appear at first sight to have been a slight increase in the number of absentees while my observations were being conducted, but a closer look at my figures[1] shows that there was no day on which there were not at one time or another at least 83 per cent of the seals

[1] Which are too long to be printed here.

accountable for, and hence only 17 per cent away. The chief change was due to the fact that fewer cows seemed to be lying on the beach than before, but these lay on the rocks or reef or in the sea in the immediate vicinity of the rookery.

There are, I think, only two deductions which can fairly be made from the above figures, and these are either—

1. All the females had pups, and in that case there was no day up to the 1st August on which a percentage of more than seventeen left the rookery for any length of time, or—

2. If the percentage of females at all times absent from the rookery is to be here applied as on the Pribilofs, the obvious deduction is that there was an unknown and somewhat considerable percentage of the females which were without pups, and which, hanging about the neighbourhood of the rookery, made up the numbers of seals which were daily to be seen.

Movements of the Pups.

The movements of the pups seemed to coincide with the rise and fall of the tide. At low tide they followed their mothers out on the reef, and slept with them on the outlying rocks. The rising tide, however, caused the swell to break over these rocks, and even to send a small breaker right across the reef. The pups always retired to the shore before this breaker, and on the day of our most successful count (29th July, at 6.15 P.M.), out of a total of 529 pups counted by myself, and 527 by Dr. Stejneger, only three were in the water or off the beach.

On these well-protected rookeries the pups learn to swim rapidly, and although up to the 30th of July there were no pups at the south rookery who dared face the surf or the waters of the deep sea, there were on that date 370 out of 530 who were capable of swimming about in the shallow water on the reef. There can be little doubt that they here learn to swim by following their mothers out on to the reef, where the rising tide cuts them off, and they are then forced to use their flippers. One little pup which Dr. Stejneger and I watched on the 29th of July had evidently never tried to swim before. It was cut off by the advancing tide while sitting with its mother on a small rock on the reef. As the tide advanced, the pup tried to balance itself on the top of the rock in a seemingly most uncomfortable position. Presently the cow moved off, and the pup had to follow her into the shallow water, but it was only after some time, and when it was teased by some other pups, that it dared to put its head under the water, and when it did do so it swam excellently.

On the 30th July a good many pups at the South rookery were still afraid to go into the shallow water, as I saw when I went down amongst them to remove some dead carcases. They must, however, have progressed pretty rapidly in their swimming lessons; for, whereas

up to the 29th July the smallest number noted on shore at any one time was 217, on the 30th July, at 8.30 A.M., there were only 160; and on the 2nd August only about 70.

On unprotected rookeries, like, say, Sabatcha Dira of Copper Island, the pups are prevented by the constant surf from learning to swim until they are bold enough to face the breakers, and so they learn to swim slightly later. Still, at Sabatcha Dira, on the 7th August, I saw a pup accompanying his mother with ease and confidence among the heavy breakers then coming in. But this was an exceptional pup; the vast majority were afraid to face the surf at all.

As soon as the pups begin to swim they amuse themselves by playing with pieces of seaweed, and no doubt anything nourishing which they come across finds its way to their stomachs. This is no doubt a preparation for their winter feeding at sea. The earliest date on which I saw a pup playing with kelp was on the 29th July at the South rookery. On the same day I saw a pup follow his mother nearly out to the breakers before he allowed her to leave him. I cannot but think that the pups must, in the first instance, gain a great deal of their first knowledge of where their food may be found by thus following their mothers away from the rookeries.

By the middle of August (first noted on August 10, 1896) the pups show signs of moulting and assuming their grey coat, their heads especially presenting a very patchy appearance. Later in the season it is a frequent sight to see pups playing with sea weed or anything else which may come in their way, and in shallow water I have seen them nibbling at something at the bottom; and, on August 17, 1896, at Copper Island, I saw a pup with something in its mouth which looked remarkably like a fish. On the 6th September 1896 I shot a puffin (*Fratercula corniculata*) on St. Paul Island, which, unfortunately, fell into the sea out of my reach. Some pups which happened to be playing near at hand seemed to take an interest in it, and sniffed at it, but I did not actually see them bite it. Again, at the landing-place at St. Paul Island, a pup was seen by me pulling at a rope on September 20, 1896. This happened again on the 24th. On that day when I was standing at the same landing-stage, a pup came swimming by without seeing me, and finding one end of the same rope floating in the water, he began to pull and play with it like a puppy dog. Presently I began to pull the rope in towards me, and had actually brought him in a bit, before he noticed my presence, and took to his flippers with a surprised hiss.

Excavations on Puffin Island.

"The place of tombs,
Where lay the mighty bones of ancient men."

By PHILIP J. WHITE, M.B., *Professor of Zoology in the University College of North Wales, and Director of Puffin Island Biological Station.*

"AND we will row to that little island of which I cannot say the name, I like it so much, it looks so lonely, just broken off, as it were, from Anglesea."

The Isle of Glannauch, Ynys Seiriol, Ynys Lenach, Priestholm, or Puffin Island, to which Edna Lyall thus refers in one of her novels, are names which have been given, from time to time in the course of history, to the small island lying like a watch-dog at the eastern end of the Menai Straits. For upwards of a decade this island has been closely associated with biological inquiries of various kinds, and the descriptions and illustrations of it have rendered it familiar to many who have neither set foot upon it nor seen it.

Like some other islands of which we know, Puffin Island has its saint. Professor Herdman, in one of his clever sketches, represents this saint, Seiriol by name, as seated on the rocky shore of the island, contemplating with complacency and evident approval a small party of zoologists trawling from a boat.[1] No doubt the mystic was interested in the biological features of the island and its surroundings in so far as his earthly wants were concerned, but more than this it would be venturesome to surmise. However, as so much good biological work had been done under his auspices, as it were, I felt that it was only right and proper that some effort should be made to investigate the ancient seat of his activities. Mr. Harold Hughes, who has been associated with me in the work of excavation, about which I shall presently speak, has examined the scanty records relating to the island, and has furnished us with a most interesting history.[2] I can but touch on it here, and perhaps cull a few lines from his narrative. In the early years of the sixth century Seiriol erected his cell on the

[1] *Fifth Puffin Island Report*, 1892.

[2] *Puffin Report*, 1894 and 1895.

island, and took up his abode there with his religious brethren. These monks or religious brethren, and those who followed them through the centuries, were known as the "Canons of the Isle of Glannauch," becoming eventually "Canons regular of the Order of St. Augustine." The life of these monks, as recorded by Giraldus Cambrensis in his *Itinerary of Archbishop Baldwin through Wales* in 1188,[1] was a simple one. He says: "There is an island, of moderate size, adjoining and almost united to Anglesey, inhabited only by hermits, living by the labour of their hands and serving God. This is remarkable that, when any discord arises among them by the influence of human passions, all their provisions are devoured and destroyed by a species of small mice with which the island abounds, but, when the discord ceases, they are no longer troubled. Nor is it to be wondered at if the servants of God sometimes disagree, seeing that Jacob and Esau contended in the womb of Rebecca; by contention Paul and Barnabas parted from one another; the disciples of Jesus strove as to which of them should be the greatest: for these are the temptations of human infirmity. Nevertheless virtue often by infirmity is made perfect, and faith is increased by tribulation. It is said, moreover, this island is called in Welsh, *Ynys Lenach*, or the Ecclesiastical Island, on account of many saints whose bodies are buried here, and no woman enters this island."

What the mice referred to above were we cannot say, but no doubt we shall find some traces of them, unless they were merely creatures of the imagination. The only rodent remains that we have hitherto found are those of the rabbit and common rat. This rat was very abundant on the island, until a few years ago, when it was exterminated.

The island seems to have been a crown-land up to 1654, when it was sold by Queen Elizabeth to one J. Moore. In the grant this note occurs—"I know not of what compase the saide Ilelande is, nor the comodities thereof. This is the furst pticular made by me of the p'rmises for this sale 29 Ap 1564." Later the island passed into the possession of the Bulkeley family, in whose hands it remains to the present day.

The excavations made by us have been chiefly in the vicinity, and to the east of the old tower standing about mid-island. Several ecclesiastical buildings appear to have been erected from time to time, and this tower formed part of the priory which was in existence in the twelfth century. Round the tower, but at ground level, there are walls, some of which belonged to the priory, while others evidently surrounded portions of the burial-ground.

In 1893 I made the first excavation,[2] a trench some fifteen feet in length, by three feet wide, and about thirty yards north-east of the tower, at a spot said to have been part of the cemetery.[3] The limestone

[1] Powel's Latin edition, 1804.
[2] *Puffin Report*, 1892 and 1893.
[3] Hopps, *Archæologia Cambrensis*, vol. xv. 1869.

was reached at a depth of three feet. In the mould, which consisted first of a layer of black earth, then of a layer of brownish earth, and lastly of a layer of brownish clay, there were, especially in the first layer, numerous bones and teeth of the ox, sheep, boar, rat, and rabbit, but no human bones were found.

I then made a shorter and wider trench about fifteen yards north-east of the tower. The soil here was about four feet in depth. As in the first trench, there was, to begin with, a layer of black earth, followed by a layer of sea-sand, below which there was a layer of brown clay. In the layer of black earth there were numerous fragments of human bones and teeth, and fragments of the bones and teeth of the animals found in the first trench. Immediately above the layer of sand a human skeleton was discovered with the feet pointing to the east. On passing through the layer of sand two skeletons were found, lying side by side, on the same level and a few inches apart, imbedded in the brownish clay. It was therefore clear that the burials had been made in two layers, one superficial and the other deep. In the latter no injured bones, or bones out of position, were found; whereas, in the former, besides the skeleton, there were many odd and injured bones, thus indicating that this layer had been used more than once for purposes of burial.

The next and principal excavation was made conjointly with Mr. Hughes, immediately to the east of the tower, on the spot probably occupied by the sanctuary of the priory. We also excavated in the floor of the tower itself. We commenced digging at the entrance of the tower, and worked outwards between two parallel walls extending eastwards from its sides. On removing about two and a half feet of debris, we came upon a wide stone forming the fore part of the threshold of the doorway. Deeper and to the east of this stone, and passing through layers of charcoal, burnt materials, and lime, to the depth of about eight inches, the thick walls of an enclosure,[1] about five feet square, were exposed. Further examination proved this to be an ancient tomb. Beneath some rough sea-worn slabs, and covered with shingle from the shore, lay, with his feet to the east, the skeleton of a man. As he was a large man, and as the enclosure, so far as its length went, was relatively short, he had been buried with the knees drawn up. Sir William Turner, to whom I sent the skeleton for examination, describes it as that of a man in the later stage of middle life, with a well-developed muscular system, a hyper-brachycephalic skull, and a good sized brain. Is it possible that these remains, occupying as they do the most important ecclesiastical site of the island, can be those of Seiriol "the Bright," of whom Matthew Arnold sings in his "East and West"? If so, this place of sepulchre might mark the position of his early cell, because, as old records show, holy men were occasionally buried in the oratory where they were wont to

[1] *Puffin Island Reports*, from 1894 to 1897.

worship. Whether, however, the remains were those of our saint or not, they are evidently those of a man of note in his day and generation.

Proceeding eastward with our excavations beyond the enclosure first spoken of, we exposed a somewhat roughly constructed sepulchral cist beside the wall on the left hand side, and resting upon the rock. When the covering slabs were removed a number of odd and broken bones belonging to several individuals were seen, and beneath these lay two skeletons, one above the other. Immediately to the right of this cist, and behind a rude headstone, another skeleton was found, and to the right of this yet another. These skeletons were not enclosed in any way, and like those in the cist, their feet were directed to the east.

Beyond these skeletons we have just found a low sandstone wall extending transversely between the two main walls within which our work at present lies. We have not traced it fully as yet, and what lies on its further side we have still to discover. In the debris within and without the tower several worked building stones were unearthed. Here and in the upper mould of the two other excavations, smoking pipes, dating from the reign of Queen Elizabeth to modern times, were brought to light, as were also fragments of Elizabethan bottles and comparatively recent gun flints.

In a small excavation which was made at the south-west extremity of the island some fragments of pottery, apparently Elizabethan, were found, and beneath these a number of sea-shells and burnt bones, while in the sandy soil to the north-west of the biological station, at a depth of two feet, a prehistoric flint was discovered.

The story of the island, from the time when this flint was used to the time when the biological station was established, is a long one. We shall endeavour to spell this story out, but in this short paper I have merely tried to indicate some points in connection with our task, which so far has been by no means a fruitless one.

Mr. F. W. Headley on Evolution.

By R. F. Licorish, M.D.

Mr. F. W. Headley is to be congratulated, from the Lamarckian point of view, on the soundness of his conclusions as to the course of organic evolution as expressed in the May number of this Journal. And yet, strange to say, I have to protest against *his* interpretation of Lamarck as stated therein. Lamarck never stated, nor did he intend others to believe, that evolutionary changes are brought about by means so simple as implied by Mr. Headley when he states in his article: "The idea that the crawling of bees or other insects over plants, or anything in the environment, can have produced flowers, is too great a strain on the credulity of an ordinary man," as an illustration of Lamarckian views. He says, "or anything in the environment," yet farther on in the article (page 362) he makes the environment play a somewhat different *rôle*, and he attempts rightly enough, so far as the explanation goes, to explain how it works. He says: "The environment offers to animals all that they require, and lets them take what they want in any way they choose." Now that is so, and it applies with equal force to plants. We should remember that the environment of plants includes all conditions capable of acting on them above the surface of the earth as well as beneath it. What Lamarck contended for was that plants are modified chiefly through their nutritive processes, and we can well assume that flowers were so evolved; changes in the nutritive processes leading to change in reaction to other environmental factors.

Now, so little has Lamarck been understood in this respect, that even one of Huxley's acumen and knowledge has been led by the misunderstanding to make statements absurd and misleading. In "Lay Sermons and Addresses," article "Origin of Species," Huxley thus writes: "It is curious, however, that Lamarck should insist, so strongly as he has done, that circumstances never in any degree directly modify the form or organisation of animals, but only operate by changing their wants, and consequently their actions; for he thereby brings upon himself the obvious question, How then do plants, which cannot be said to have wants or actions, become modified? To this he

replies that they are modified by the changes in their nutritive processes, which are affected by changes in their circumstances; and it does not seem to have occurred to him that such changes might be as well supposed to take place among animals." That plants cannot be said to have wants is rather a strange assertion from a scientist of Huxley's eminence, and the statement that it did not occur to Lamarck that changes in animals take place through their nutritive processes, as he alleges they do as regards plants, is a deplorable bit of gratuitous imputation for a great reasoner like Huxley to make, seeing that Lamarck was continually reiterating that fact. For certainly Lamarck's "wants" include the want of food, and if circumstances force animals to modify their method of feeding, a new habit will or may be contracted, leading gradually through heredity to modification of organs. Again, we see the misinterpretation of Lamarck in Mr. Herbert Spencer's "Principles of Biology," when he implies that the idea as to what induces organic change in the theories of Erasmus Darwin and especially Lamarck, is identical or very similar to the motive force implied in "Vestiges of Creation" and Prof. Owen's works whereas there is no real likeness, or, in fact, no more than is between the vitalist's theory of life and that of the physicists.

I agree entirely with Mr. Headley when he states that the guiding principle of evolution must be sought for in the organism itself; for that is what Lamarck ever maintained. Again, Mr. Headley states that the paths open in the evolution of species are limited. That is also true, and for the simple reason that they must follow the lines of function. Take up any work on physiology, and we soon learn why the paths of evolution are limited, for organic life depends on only a few great functions, viz., nutrition, including respiration, reproduction, and locomotion, all governed by the nervous system, and hence it must be on these lines—the great vital functions, as distinct from the special organic functions—that evolutionary changes are brought about when changes in environment lead to change in organic reaction in the formation of new species.

It seems to me we should look at organic matter as a *condition of energy, i.e.*, as, in a highly plastic state, capable of being modified either directly or indirectly according to the *exigencies* of the organism. Weismann now admits (a modification of his former views) that variations are caused by the reaction of the germinal protoplasm to extrinsic forces. But why does he not see that this reaction to extrinsic forces is not limited to embryonic life, but is continuous during the whole life of the organism, from inception of life to death, gradually decreasing, of course, in inverse ratio with the duration of life of the organism. We should thus be able to account not only for variations appearing at birth, but also for the inheritance of functionally-produced modifications.

That the course of organic evolution is gradual—one step in a

definite advance being the basis of the next step—is also a purely Lamarckian conception, although Mr. Headley attributes it to Eimer. As regards Mehnert's principle of development, summarised by Prof. Thomson in the May number of *Natural Science*, that, too, is Lamarckian, for Lamarck's work clearly makes out that all progress in organic evolution must be studied from the physiological or functional standpoint. Hitherto it has been studied almost wholly from the morphological point of view. But that this limitation is fallacious must be plain if we admit that "the function makes the organ."

That any course in evolution can be due to chance, and not to responses to environmental changes, is to me unthinkable, for, look where we will, consider what we may, law and order prevail in nature.

BARBADOS, W.I.,
May 25th, 1899.

Meteorology and Ethics.

In days whose distance from those of our enlightenment is not great when measured chronologically, though vast when estimated in terms of mental modification, the organism's dependence on its surroundings was unrecognised, and man was master of his fate. But we have changed all that,—the organism is now a whirlpool in the sea of life, and, "man is being recognised more and more as a creature of his environment, a sequence of personalities, each one of which varies from all the others as the conditions of that environment vary." Instead of *coelum non animum* we read *coelum et animum*, and the days of the study of the personality *in vacuo* have passed away for ever. And so we react from a false abstraction to hardly less obvious exaggeration. Flowers shaped insects' mouth-parts and insects formed the curves of flowers, the popular Lamarckian says, in the exuberance of his confidence in modifications and their heritability; and as for our vices, it is the fault of the weather. The environment, in short, has to serve its turn as the scape-goat of the human camp. But just as there was truth in the old doctrine of the organism's independence and man's mastery of circumstances, so there is truth in the modern reaction; and we have read with great pleasure, which we wish others to share, Professor E. G. Dexter's clever and careful essay on "Conduct and the Weather: an inductive Study of the Mental Effects of definite Meteorological Conditions" (*Psychological Review*, Monograph No. 10, vol. ii. 1899, pp. 103, 14 figs.). We hope no one will be unkind enough to recall the line "For now, these hot days, is the mad blood stirring"—it may be cool enough before this note is published—for the thesis which we would report on is no *jeu d'esprit*, but a sober induction.

The meteorologists are probably too busy with the affairs of their own young science, to care as yet much for the inspiration which comes from a contact with other disciplines; yet if there is one thing that the history of science teaches clearly, it is the value of interactions between the various departments of scientific inquiry. That meteorology touches biology at every corner is well known, for whether we study Palolo or the Plankton, migration or the mammoth, whether we take up Bonnier's recent studies on alpinisation or Clement Reid's newly published essay on the origin of the English flora, we have to

utter to the meteorologists the almost proverbial cry of the men of Macedonia—"Come over and help us." It is possible, however, that there may be meteorologists wise enough, ignorant enough, and humble enough to be assured through the medium of *Natural Science* that their data have a profound bearing on Ethics.

Our author tells us that "the modern science of Meteorology, emerging from the mist and darkness of ignorant guess and surmise has left its path strewn with many a shattered idol. Jupiter Tonans the Thunderer, Pluvius the Rain-maker, and a hundred other weather-gods were toppled from their lofty pedestals ages ago, while St. Swithin and his two-score of saintly colleagues, whose days dominated the weather for the rest of the year, have been quite as surely if more recently dethroned by the delicate instruments and skilful calculations of the modern weather-man." But the dethroning is evidently to be followed by an enthroning, and le roi qui vive is Weather. Quietly but firmly it dominates us all,—how effectively, it is the business of Mr. Dexter's essay to show.

It is of course a familiar saying and saving-clause of the physician that this or that is due to the weather, and he has accumulated here and there no small basis for his platitude. But mental states, especially emotional states, are affected, through the medium of the body, by the conditions of the weather, and thus the connection between meteorology and ethics is securely established. Indeed, it is generally recognised, though its inductive elaboration has been hitherto neglected. "There are many persons who are simply victims of the weather." "How inconsiderate are our friends when the east wind blows and the skies are heavy." "How dangerously doubtful seems to-day the venture which yesterday, in the bright sunlight, seemed certain of success." We have already detected the influence of the weather in the pages of our journal.

The poet as well as the physician has recognised the dominance of weather-influence; as hyperaesthete he feels it more keenly than most; as seer he has, as in so many other instances, the right of priority over science in the discovery which Mr. Dexter expounds. Although many may not accept the utterance as authoritative, it is of interest to note Byron's remark—"I am always more religious on a sunshiny day." But even more convincing is Southey's complaint, made during one of his visits to England after a long sojourn in Italy—"I miss the sun in heaven, having been upon a short allowance of sunbeams for the last ten days, and if the nervous fluid be the galvanic fluid, and the galvanic fluid the electric fluid, and the electric fluid condensed light, zounds! what an effect must these vile, dark, rainy clouds have upon a poor nervous fellow like me, whose brain has been in a state of high illumination for the last fifteen months." Professor Dexter also points out how the plot in Romeo and Juliet hinges upon the weather. What a wealth of meaning there was in Benvolio's apparently simple remark—"The day is hot."

But we must remember where we are and the solemnity of facts, and state the problem. *Have the various meteorological conditions, ringing in as they do combinations innumerable, a definite causal relation to human conduct?* Does the ever-changing weather present conditions in which impulse to action is more liable than usual to overcome an ordinarily overpowering inhibitory force?

The problem was attacked in two ways: "first, by the tabulation and discussion of a questionnaire sent to nearly two hundred teachers of all grades, from the kindergarten to the high school, superintendents of asylums and reformatories, and wardens of prisons and penitentiaries;" second, by an inductive study of several hundred thousand data correlating weather and conduct. It is evident that the possible fallacies are so numerous that a large body of results were necessary before any reliable conclusions could be drawn, and it is for those accustomed to statistical inquiries to say whether Professor Dexter's industry was or was not sufficiently prolonged to allow of the elimination of errors. However this may be, he certainly has not spared trouble in seeking to substantiate his thesis, and Mrs. Dexter also shared in bringing the immense labour of tabulation to a successful issue.

It should also be recognised that the author does not take any crude or easy-going view of his problem. He has realised the complexity of the factors which influence conduct, and the difficulty of analysing out those which may be called meteorological. As an instance of this, we venture to give a quotation—one of the many pleasant interludes in his serious argument.

"The idea that the prevalence of suicide in this country (England) is due to our bad weather is precisely one of those hasty and illogical inferences which are characteristic of the Gallic mind. The constant gloom of bad weather ought to acquaint us so thoroughly with moods of depression that suicide would never occur to us. Look at Scotland, for instance, where suicides are rare. Why are they rare? Simply because a succession of Scotch Sundays has so accustomed the people to prolonged despondency, that any sudden misfortune cannot sink their spirits any farther. One has only to spend a dozen Sundays in Glasgow or Edinborough (*sic*) to become inoculated against suicide." . . . . As Dexter says, there is truth beneath the jocular vein of this quotation.

The results of the study lead to the following five conclusions:

I. "*Varying meteorological conditions affect directly the metabolism of life.*" Some of the conditions accelerate the oxidising processes of life, while others retard them; the former are called by the author anabolic, the latter katabolic, and we would accent his hesitation in using these terms, with the remark, that he thereby darkens his counsel with words without knowledge. Any other terms would have done as well, for no others could be worse.

II. *The 'reserve energy' capable of being utilised for intellectual processes and activities other than those of the vital organs, is influenced*

to a marked degree by meteorological conditions." Again we must demur most emphatically to the quasi-physiological expression which the author uses in summing up his results. His conception of "reserve energy" is a reflex of a commercial environment, and appears to us quite inapplicable to the real business of metabolism. It is an unconscious 'materialism'—an attempt to give a false simplicity to the facts.

III. "*The quality of the emotional state is plainly influenced.*" "It is safe to say that high conditions of temperature and humidity, cloudy and rainy days, and for many people high winds, are generally productive of more or less negative emotional states; while moderate and cool temperatures, low humidities, mild winds, and clear days are usually positive in their effects." But, as the author says, this thesis must be defended by means of an analysis based solely upon introspection; and though he tries to connect it with his doctrine of "reserve energy" he is not certain about it, and it is just as well.

IV. "*The reserve energy and the emotional state are both factors in the determination of conduct.*" Here the author seeks to show that his theory of "reserve energy" accounts for the discrepancies which are apparent on the supposition that the emotional state is the only factor.

V. "*Conduct, in the commonly accepted sense of the term, Death and Intellectual and Physical Labour bear very different relations to reserve energy.*" "As a conclusion, it would seemingly be safe to say that of the activities (or cessation of activity) possible to human beings, some are the result of excessive vitality, and others of deficient states;" and that, generally speaking, "those misdemeanours which have been classed under our study as those of conduct are the results of the former, while death is an accompaniment of the latter."

As it seems to us, the conclusion of the whole matter is that the author has brought forward strong evidence to substantiate the thesis that there is an indirect causal nexus between weather and conduct. But we do not feel sure of anything else in his results, and particularly we would respectfully suggest to him, that he has departed from the scientific method by mingling with his inductive results a physiological theory which is probably erroneous and certainly unnecessary.

X.

The Comparative Chemistry of our Forest Trees.

By P. Q. Keegan, LL.D.

By the chemistry of trees is meant not the special detection and demonstration of the chemical forces which exert energy within the living arboreal organism, but rather the detection and assignment of such separable and distinctive organic and inorganic bodies as are incidental to the vital processes thereof, whether these bodies furnish the stroma of the actual life, or are merely bye- or waste- products of the spent and exhausted activities. The tree, indeed, may be regarded as the outward and visible sign of an inward and wholly invisible force. The capital force is the mysterious one called "vital;" but chemical forces and their visible or detectable products, which here alone concern us, are set agoing thereby, and are manifested as a heritage or inevitable consequence. Nevertheless, it is absolutely certain that some of the most brilliant, beautiful, and distinctive constituents of the tree—of its stem, leaf, and flower—are not the results of any chemical processes known to us, and cannot possibly be artificially reproduced by the most capable and dexterous application of the latest and most approved synthetic methods and expedients.

The arborescent forms of the forest flora of the British Islands are not very numerous, but (native and denizen species included) they are sufficiently varied to render an account of their chemical constituents exceedingly interesting and instructive. If, for instance, we desire to study the chemical characteristics of the Gymnosperms, we can forthwith fasten on that stately and sombre-foliaged tenant of our upland wastes and craggy mounds known as the Scotch Fir (*Pinus sylvestris*). Perhaps we have been accustomed to consider the leaf as the most vigorously active of the vegetable organs, but here we see that a mighty portion of the energy is delegated to the woody tissues. For what is the meaning of the resinous matter which is so characteristic a constituent of the Coniferae, and the origin of which has been the theme of such acute and prolonged controversy? Some specially active mother-cells containing an opaque plasma, and situated in the external heart-wood, divide and divide again with great energy, separating from the adjoining tissue, and forming four to eight or more daughter cells

which split asunder internally, leaving a hollow space (resin-passage) into which there flows the product of their spent and exhausted labour (destructive metabolism), viz. the resin. Physiological operations of this very pronounced and particular nature are rather rare in the woody tissues of the stem and root of our Dicotyledons. Then again, we can attest the curious transformations which the starch, fatty, and resinous constituents of the wood of the Scotch Fir undergo at the different seasons of the year. According to Fischer there is no starch at all in the wood, pith, or bark during the winter; and Jonssen asserts that at this season the wood is entirely devoid of starch in all parts, but bears a considerable quantity of fat-oil, finely distributed, which disappears in April, while during the summer the wood is very poor in fatty matter. The needle-shaped evergreen leaves, again, are divested of starch in winter; but about the 1st April, even while the chlorophyll is still in the wintry condition, and although a low temperature and no special sunlight may occur, these organs are found crammed full of starch. So that here a very remarkable phenomenon is presented, viz. a plenteous production of starch following quickly on the winter sleep, and under conditions the very reverse of those which, in most of the dicotyledons of our latitudes, are indispensable for accomplishing a precisely similar effect. In fact, certain still undetermined causes, operative after a kind of pre-ordained periodicity, seem to dominate the physiological action of the protoplasm of these extraordinary foliar organs. Coniferous leaves are always much poorer in nitrogenous and in mineral constituents (ash) than those of deciduous trees, and the ash generally contains larger amounts of magnesia, iron, and silica. On the whole, it may be concluded, from a study of the character and quantity of the chemical constituents, that the coniferous Gymnosperms are subject to a fitful periodicity of physiological energy, interrupted by corresponding and longer periods of repose akin to hibernation, which permit of extensive accumulation of "dry substance" in the tissues under the form, more especially of the products of de-assimilation (tannoids, tannins, glucosides (coniferin), resins, waxes, and volatile oil), while on the other hand the products of assimilation (starch, fat-oil, and nitrogen-compounds) are relatively and absolutely scanty.

Reviewing now the more extensive and familiar field of the Dicotyledons, we are impressed not only by the comparative chemical similarity of certain of the woodland organisms, but also by the fact that a few other groups stand forth singly and, as it were, with an isolated heterogeneity as remarkable as it is apparently inexplicable. Peering adown the wondrous vistas opened out to us by the resources and appliances of chemistry, the squabbles of the "splitters" and "lumpers" of the would-be systematic taxonomists seem fantastic and puerile; the hair-splitting agreements or otherwise in the essential or unessential superficial characters of the organs of reproduction, etc., are liable to be contemned or wholly ignored. We find that species of trees very

closely related in systematic affinity are anything but very closely related as respects their physiological faculties, the sweep and potency of their vital energies, inasmuch as we can now attest and demonstrate that the inevitable chemical products thereof are, in the two cases, mightily different in quality and quantity. Bonnier has remarked that "the anatomical structure of a plant cannot always be deduced from its physiological functions; two plants, for instance, having similar chlorophyllous tissues may have very different powers of assimilation, and plants are known which have a palisade tissue more developed than others, but which, nevertheless, possess much feebler chlorophyllian functions." But where morphology fails, chemistry braces up in aid; and yet with all its magnificent powers and abundant resources it does not presume to be able to explain why or how it happens that one or two of our heath and forest species of the extensive order Amentaceae should be pre-eminent producers of fatty matters, leaving the rest shivering, as it were, in the cold of a lavish receipt and a thrifty expenditure of carbohydrates. I will now briefly pass in review the principal chemical features and characteristics of the dicotyledonous forest flora of our country.

The various species of Elm (*e.g.*, *Ulmus campestris* and *montana* and their varieties), in conformity with their lowly systematic affinities, exhibit nothing very advanced or developed, but rather a kind of degradation in the direction of a very facile production of that *bête noire* of the plant analyst known as vegetable mucilage. In the cortex special sacs evolved from the meristem, and due to a destruction of living cells with formation of cavities or canals, contain mucilage in large quantity; it is a pectosic mucilage with acidic function, being coloured by basic dyes; it swells up and almost wholly dissolves in water, but is not derived from cellulose. Some resin occurs in elm bark and wood parenchyma, but the quantity of tannin, phloroglucin, etc., is decidedly scanty in all parts. The leaves contain much carotin, considerable wax, and a little fat, and their starch-producing power is undoubtedly vigorous. In fact, the Elm is a very distinctive and decisive starch-tree, exhibiting a protoplasmic concentration rather uncommon; the lavish fortification of its bark and leaves with lime and silica, and the ability of some of its varieties to form a primary, persistent periderm, though only feebly suberified, are features clearly suggestive of the special quality of its activities.

Passing on now to these interesting morphologically allied congeners the Birch and the Alder, we realise in a striking degree the supreme value of chemical analysis in its application to botanical science. These two species are closely related taxonomically, and yet when chemically investigated we almost immediately discern very serious differences in respect to physiology. Both are fat-trees, *i.e.* during the winter no starch is found in the pith, wood, or bark, or in other words, their leaves are incapable of producing much starch, and the amylaceous

reserve is feeble and readily exhausted. So far they agree, but in the Birch the process of de-assimilation is not so complete as that in the Alder. In the former it is not pushed much beyond the lavish production of colourless waxes, resins, and volatile oils, and hence the outcome of the tannins, phlobaphenes, pigments, etc., is considerably restricted. The result is, that in the "queen of the woods" we have a silvery whitish bark with about 30 per cent white resin (betulin) approaching a wax or camphor in character, and only about 5 per cent tannin (all too feeble to impart a crimson coloration to the autumn leaves), together with an amount of phlobaphene too small to overpower the predominant suberification. The bast of this tree exhibits considerable lignification, but it is clear that the phellogen is perhaps the most active formative tissue in the entire rind. The case is pretty much reversed in the marsh-loving Alder wherein de-assimilation seems to reach its highest intensity. The bark of this tree sometimes contains as much as 20 per cent of a tannin which is highly carbonaceous, and very readily forms high red-brown and muddy shaded anhydrides of an eminently antiseptic character. The tannin penetrates freely into the medullary rays, parenchyma, and pith of the wood (it is very sparse in birch wood); in fact, without a doubt the Alder, taken all in all, is by far the most richly tannin-bearing of all our forest trees, and this constituent is of such a character and composition that it subserves the purpose of lignification rather than of embellishment, for as a chromogen it is useless save for colours dark and dun. The leaves contain a darkish brown oily matter, while the bark of the twigs encloses a bright yellow pasty mass of fat, wax, and a trace of volatile oil; carotin is very scarce even in the leaves. Cells filled with a homogeneous phlobaphenic matter seem mostly to replace or represent the highly suberified periderm of its congener the Birch.

The members of the sub-order Cupuliferae, viz. the Oak, Spanish Chestnut, and Beech, are more closely allied in chemical respects than the two foregoing species. No member of the vegetable kingdom has been more thoroughly and exhaustively investigated than the Oak. The peculiar shape of its leaves is no pledge of their physiological faculty, which is extremely powerful. The amount of starch which this tree produces and stores up (there is 37 per cent in the acorns) is, I think, considerably greater than that of any tree in our woods. A very distinctive variation is, however, observable in the Beech, where even in January and February the wood is very rich both in oil and starch, every cell of the parenchyma in the outer rings being full of the latter (which is not the case in most starch trees), and this predominance continues up till April when the wood is found still to be rich in oil (in fat-trees generally there is little oil in spring or summer). In fact, the Beech, chemically speaking, is a peculiarly eccentric organism. Even in its most massively developed trunk there is no marked distinction between the heart-wood and the

splint-wood; the wood-elements seem only very slowly to become completely lignified, and although the ratio of "incrusting matter" therein is ultimately extremely high, there exists only a very small quantity of tannin and that only infiltrating the walls; in the inner rings there is a specially abundant store of starch laid up to meet the tremendous drain of the "seed-year," this starch gradually changing into drops of wood-gum (xylan). Moreover, it requires more nitrogen than most other trees, and needs a plentiful supply of potash. The external economy, too, is as remarkable as the internal. The cortex is a veritable curiosity. "The whole tree," says Wicke, "sticks, so to speak, in a siliceous coat of mail, the silica forming a thick solid crust over the whole stem and the young twigs." The bark is said to contain 70 to 90 per cent of oxalate of calcium. Beech leaves are eminent for their large percentage of fatty matter, fibre, lime, silica, and manganese. In view of the considerable amount (some 25 per cent) of oil in the nut, the enormous affluence of starch, and the poor 2 per cent of tannin in bark and leaves, we can have no hesitation in pronouncing the Beech to be the most vivaciously active and powerful assimilating organism of our woodlands. Finally, how it happens that the Spanish Chestnut should specifically and exclusively produce the particular tannin called gallotannin in the bark and the wood (each contains about 7·5 per cent, the leaves about 6 per cent), is one of the mysteries shrouded beneath the impenetrable and inscrutable veil of forest secrecy.

Passing by the Hazel, Walnut, etc., which are not strictly speaking forest trees, we now approach a mystic tenant of the woods, a true native, and abundantly familiar, but which challenges the utmost possible chemical consideration that can be bestowed upon it. This is the common Ash (*Fraxinus excelsior*), and no lynx-eyed acuteness is requisite to enable anybody to perceive that even exteriorly it differs immensely from its arboreal neighbours and confreres. The smooth olive-grey bark, the astonishing knotty protuberances of its bursting flower-buds in spring, the almost absolute freedom from any intrusive or brilliant colorific effect in any of its members or organs, are so many tokens and pledges of characteristics entirely uncommon. It is a starch-tree, but its seeds contain 16 per cent of oil and no starch, and, moreover, on analysis one finds in the various organs such a considerable amount of waxy, resinous, and fatty matter, and such evidences of a facile decomposition of such carbohydrates as are produced in its leaves, that its claim to enrolment in the order Oleaceae is seldom questioned and never belied. In 1840 Gmelin had noticed a peculiar iridescence among the constituents of the bark of *Fraxinus Ornus;* but in 1856 Salm-Horstmar discovered a similar fluorescence in the infusion of the bark of *F. excelsior*, and in the following year he isolated, examined, and called it *fraxin*. Its dilute aqueous solution exhibits by reflected daylight a strong blue or blue-green fluorescence

which is destroyed by acids and increased by a trace of alkali. Fraxin is a colourless crystalline glucoside of a feebly bitter taste, and seems to be related to quinic acid or hydroquinone. The tannin of the Ash is totally different from that of any of our native or denizen trees: it is distinctly iron-greening, is not a glucoside, does not yield anhydrides by the action of acids, but only by heating dry or by repeated evaporation of its solution, when brown substances (recalling the dun shade of the autumn leaves) are produced, and finally on potass-fusion it yields protocatechuic acid but no phloroglucin. In fact, it is doubtful if any constituent with a phloroglucin nucleus occurs in the entire organism; for the quercetin found in the leaves from birth till late in August shows at all times reactions more like those of a tannin than of a mere tannoid compound. The leaves may be regarded as among the wonders of British botanical chemistry. Replete with chlorophyll and carotin, they contain much starch, fat, and resin, and from 6 to 9 per cent mineral matters (ash), but they are specially distinguished by the number and variety of decomposition products, which constitute an exceptionally high non-nitrogenous extract consisting of quercetin, tannin, inosite, mannite, glucose, gum, mucilage, malic acid and its calcium salt in astonishingly large quantity. On the whole, we see that the small and short-lived leaves of the Ash are extraordinarily active, and we are impressed by the apparent contradiction between the enormous percentage of mineral matters indicative of an intense transpiration and the small number (150) of stomata per square millimetre of epidermis; the carbohydrates produced on assimilation are largely oxidised to acids, but the chlorophyllian protoplasm itself in its descent on exhaustion stands hesitating, so to speak, on the first round of the ladder, the not very oxidised tannoids.

Much instruction and edification would doubtless be gained by a specific recital and description of the chemical constituents of the arborescent Rosaceae, *e.g.* the wild cherry, the rowan tree, etc., with their wondrous plethora of products of de-assimilation and of carbohydrate degradation; but as these are assuredly scattered and not forested, I now pass on to a tree which, although not a sterling native, has yet been frequently artificially planted in our parks and groves on such a plan and with such effect that the serried outskirts of a dense forest—vast columns upholding a dome of leaves and flecked with white clusters of blossoms, have at least been suggested. This is the beautiful Horse-Chestnut (*Aesculus Hippocastanum*), and truly there is something very satisfactory in the chemical distinguishment and examination of so many constituents that are comparatively simple and afford atomic groups more or less harmoniously proportionate. The well-known tannin, $C_{26}H_{24}O_{12}$, for instance, has a number of atoms of hydrogen nearly equal to those of carbon, and exactly double those of oxygen; hence its reactions come out very decisively, the deficiency in carbon being a great help towards the ready production of a series

of beautiful anhydrides, which never reach the humus-like, dull, dirty browns yielded by other tannins. The most striking constituent is the highly fluorescent aesculin described by Martius and St. George in 1818; it is related to the fraxin of the Ash, and this latter is also contained in the tree under review. In the bark a fluid oil, phlobaphene, and very small quantities of aesculetin and its hydrate, are also found. The leaves are eminent for their richness in carotin in early June, their abundance of queraescitrin (glucoside of quercetin), fat, wax, phlobaphene, and resin, and much tannin in autumn. The seed contains about 4 per cent fatty oil and 14 per cent starch, also fruit sugar, and a series of curious glucosides and bitter principles representative of proteid disorganisation. It is rather a remarkable feature that this tree and its allies exhibit very slight indications of the presence or decomposition products of gum, mucilage, etc.; they are all starch-producing trees, but apparently there is no superfluity, waste, or prodigality of this substance, and at the same time, and especially in some of the maples, there is an abundant deposition of waxy matters, and of siliceous incrustations. It is quite possible that some of the foreign species of Sapindaceae unknown to me may be practically fat-trees. On the whole, this order is extremely interesting; and coming away fresh from its analysis, we are impressed with the struggle, as it were, between the starch and the fat—the sugar rising into a supremacy, culminating in *A. saccharinum*, and with the lavish abundance and superb beauty of the products of de-assimilation.

One more tree remains to be noticed, viz. the Linden (*Tilia europaea*), which possesses morphological and chemical characters of extraordinary interest. It is the most pronounced fat-producing member of our woods. Its seeds contain no starch, and very little carbohydrate, but store up 58 per cent of a bright yellow non-drying oil. The wood seems to have some difficulty in parting with its reserves of fat, which remain, especially in the older rings, up till June or later, and the starch that creeps into its place begins to dissolve early in the autumn, none whatever remaining in the pith, wood, or bark during the winter. A special peculiarity of the tissues is the inconvenient abundance of mucilage both in the intercellular spaces of the parenchyma of the primary cortex and in the epidermis of the leaves. The large and very conspicuous sieve-tubes of the inner bast contain very thick, mucilaginous masses of albuminoid matters, but no starch. The amount of mineral matters in the leaves is very great, and in autumn they are incrusted with silica. On the whole this tree exhibits, except as regards starch, a very considerable energy of assimilation; and if some of its outcome tends towards decomposition or degradation, the proportion of the higher products of de-assimilation is decidedly not relatively high; in fact, those which depend on the destructive metabolism of starch are, under ordinary conditions, markedly absent.

PATTERDALE, WESTMORLAND.

FRESH FACTS.

A Strange Dish. K. Kishinouye. "Edible Medusae," *Zool. Jahrb.* xii. 1899, pp. 205-210, 1 pl. 1 fig. Mr. Kishinouye of the Imperial Fisheries Bureau, Tokyo, has described two rhizostomatous medusae (*Rhopilema esculenta* and *Rh. verrucosa*) which are used for food in Japan. The animal is preserved with a mixture of alum and salt or between steamed leaves of Kashiwa, a kind of oak, with the application of slight pressure. To prepare the preserved medusa for the table, it is soaked in water about half an hour, then taken out and well washed, cut into small pieces and flavoured. It is easily masticable and furnishes an agreeable food. It is also used as a bait for the capture of file-fish (*Monacanthus*) and sea-breams (*Pagrus*). The latter are said to accompany shoals of the medusae.

An Early Cry. K. Fischer Sigwart. "Biologische Beobachtungen an unsern Amphibien. ii. Der Laubfrosch, *Hyla arborea*, L." *Vierteljahrsschrift Nat. Ges. Zürich.* xliii. 1899, pp. 279-316, 1 pl. From this entertaining account of observations on the "tree-frog" we select one note which is probably fresh. The observer has detected, quite apart from the breeding calls and the ordinary summer voice, a special strong cry of distress ("Angstschrei") uttered on an occasion of peculiar anxiety. As amphibians were probably the first vertebrate animals to find a voice, this observation of a cry of distress or alarm has peculiar interest.

What is the Difference between a Lake and a Pond? Otto Zacharias. "Ueber einige biologische Unterschiede zwischen Teichen und Seen," *Biol. Centralbl.* xix. 1899, pp. 313-318. The difference has hitherto been defined physically in terms of depth, etc. Thus R. Chodat, in his "Études de biologie lacustre," says that the minimum average depth for a true lake is 20-30 metres. But Zacharias shows that there are also distinct bionomical differences in the plankton, various algae, rotifers, etc., being dominant in ponds and sparse in lakes, and *vice versa;* and he substantiates this in some detail.

Artificial Production of Alpine Characters in Plants. Gaston Bonnier. "Caracterès anatomiques et physiologiques des plantes rendues artificiellement alpines par l'alternances des températures extrêmes," *Comptes Rendus Ac. Sci. Paris,* cxxviii. 1899, pp. 1143-1146. Continuing his experiments on this interesting subject, Bonnier finds that plants subjected to a daily alternation of extremes of temperature, tend to have more marked development of protective tissues, smaller and thicker leaves with a greater development of palisade tissue, frequent redness due to anthocyan, more assimilation per unit of surface, and relatively large flowers slightly less coloured than the normal.

Anal Glands of Dytiscidae. Fr. Dierckz. "Sur la structure des Dytiscides et le prétendu rôle défensif de ces glandes," *Comptes Rendus Ac. Sci. Paris,* cxxviii. 1899, pp. 1126-1127. According to this investigator the anal gland of *Dytiscus* is a unicellular gland facilitating the respiratory function

by secreting an oily substance which keeps the water out of the respiratory reservoir under the elytra. The defensive apparatus of which Bordas speaks is the rectal pouch.

FREEZING EGGS WITHOUT KILLING THEM. ÉTIENNE RABAUT. "De l'influence de la congélation sur le développement de l'oeuf de poule," *Comptes Rendus Ac. Sci. Paris*, cxxviii. 1899, pp. 1183-1185. Continuing experiments begun by his master, the late Camille Dareste, Mr. Rabaut finds that eggs exposed for half an hour in a freezing mixture at $-15°$ C. are not killed. Lasting perturbations are induced, and after warming (quickly or slowly) most of the eggs show in three days a proliferating blastoderm spreading over the yolk, but without trace of embryonic differentiation. Some showed abnormal embryos, and a very few—proving the individuality of the egg—were normal.

A SEXUAL PECULIARITY. A. KOWALEVSKY. "Quelques mots sur l'*Haementeria* (*Clepsine*) *costata*," *Comptes Rendus Ac. Sci. Paris*, cxxviii. 1899, pp. 1185-1188. In this leech there is marked protandry, and exchange of spermatophores occurs between the male organs at a period when the female organs are still rudimentary. Kowalevsky believes that the same phenomenon will be found to occur in other Hirudinea, such as *Piscicola*, the fish-leech.

EGG WITHIN EGG. FRANCIS H. HERRICK. "Ovum in Ovo," *Amer. Natural.* xxxiii. 1899, pp. 409-414, 3 figs. The occurrence of an egg within an egg is not a fresh fact, but it is often supposed to be. Mr. Herrick classifies the cases on record in two sets:—(i) enveloping egg usually normal, but occasionally of large size; blastoderm recorded in at least one instance; (ii) enveloping egg of colossal size, complete, with blastoderm probably present. One interpretation, which covers a number of cases, supposes that the small included egg represents a fragment of a normal ovum which has been ruptured in the upper part of the oviduct, or at least after the first layers of albumin have been added to the normal egg. It is possible that any substance which serves as a local stimulus to the upper part of the oviduct, whether coming from the ovary as abortive egg or egg-fragment, or from the duct as secreted product, may serve as a nucleus about which an egg-like body may be formed. Various inclusions which are not true eggs at all may be taken up by the egg and imbedded in it. But in other cases, such as double or triple yolk eggs, we have to deal with a fusion of the albumin in two or more ova, which are treated in the uterus as one egg and surrounded by a single shell. This process may sometimes be complicated by the inclusion of a third egg of normal size and already covered by a hard shell.

EXCRETION IN MOLLUSCS. L. CUÉNOT. "L'excrétion chez les mollusques," *Arch. Biol.* xvi. 1899, pp. 49-96, 2 pls. The injection method of studying the excretory function has led Mr. Cuénot to conclude that there are three seats of the process in molluscs:—(*a*) the nephridia, (*b*) closed cells isolated in the connective tissue or concentrated in the vicinity of the heart, and (*c*) in gasteropods, certain cells of the liver.

CEPHALIC EYES OF BIVALVES. PAUL PELSENEER. "Les yeux céphaliques chez les Lamellibranches," *Arch. Biol.* xvi. 1899, pp. 97-103, 1 pl. Pelseneer has now published a fuller account of the discovery, to which we previously referred (*Nat. Sci.* xiv. 1899, p. 6), and has given a plate. To what was then reported, we may add Pelseneer's note that the larval eye was seen in *Mytilus* and other forms by Loven (1848), and in *Mytilus* by Wilson (*Fifth Annual Rep. Fishery Board of Scotland*). Pelseneer has shown its persistence in various adults. As there was a misprint in one of our previous sentences, we may further note that the eyes do not make their appearance in *Mytilus* until after the formation of the first branchial filaments.

SOME NEW BOOKS.

THE SENSE OF HEARING.

L'Audition et ses organes. By Dr. M. E. Gellé. 8vo, pp. 326, with 67 figs. (Bibliothèque Scientifique Internationale). Paris: Félix Alcan, 1899. Price 6 francs.

This is a work of great interest, in which the author has brought together the results of modern scientific investigation on the structure and functions of the ear. It is divided into three chapters, the first dealing with sonorous vibrations, the second with the structure of the ear, and the third with auditory sensations. In the first there is a fairly complete discussion of the physical phenomena of sound—duration, intensity, timbre—but the application of Ohm's law regarding the composition of compound vibrations, and of Fourier's theorem to the analysis of curves, has not received much attention. It is impossible to obtain an adequate conception of the phenomena of hearing without the aid of these fundamental principles. The novelty of Dr. Gellé's book is that, for the first time, there is a systematic study of phonograms, or the tracings made on the wax cylinder of the phonograph. Many examples of these tracings are given from the writings of Hermann, M'Kendrick, Maragi, and Marichelle, in which the curious marks are seen, both as depicted by photography, as by Marichelle's method, and by graphic tracings, as recorded by the method of M'Kendrick. These tracings show many of the phenomena of tone to the eye of the observer; the number of the marks in a given time (or the duration of each mark) indicating pitch, the depth of the mark intensity, and the character or form of the mark quality or timbre. The interpretation of the curves, as photographed from above, is, however, much more difficult than that of the curves traced by a graphic method, and much yet remains to to be done. Dr. Gellé shows the marks or curves obtained from tracings of musical tones, as produced by various instruments, and also the tracings of syllabic sounds and words.

The character of a word is clearly brought out. It is a series of more or less explosive sounds linked together by vowel tones, each sound and tone having its own peculiar record of vibrations, the number of which depends on the length of time occupied in the pronunciation of each phone, or distinct and separate sound. Little has yet been done in the analysis of consonantal sounds and syllabic sounds, so that we may regard this department of phonetics as still in its infancy. The time may come when the educated eye, even from a tracing of nature's *long-hand* system of recording vibrations, will be able to recognise the word recorded; but at present that is impossible.

The only part of the second chapter calling for special notice is the elaborate description given of the deep roots of the auditory nerve. It is certainly remarkable that this nerve has more intricate connections with various parts of the encephalon than are possessed by any other nerve. As this is the case,

more especially for the cochlear division, the view is strengthened that this is the part of the nerve really connected with hearing, while the vestibular portion has to do with the transmission of the result of pressures connected with the sense of equilibrium and the position of the head (and perhaps the body) in space. True auditory impressions not only pass to their appropriate centres in the cerebrum but they may arouse, in a reflex way, many motor mechanisms, by their transmissions to the deep origins of probably all the motor cranial nerves. This striking fact suggests an explanation of how it is that music penetrates into the very roots of our being, and thrills us through and through.

At the close of the book, there is an interesting chapter on the results of pathological inquiries into the condition of the internal ear in deafness, and in cases of deaf-mutism. These results all support Helmholtz' theory of the analytic action of the cochlea. The real difficulties in the way of the full acceptance of this theory, namely, the perception of noise and the nature and influence of combinational tones, are not discussed.

The value of the book is lessened by the want of a good index. Altogether this is an excellent work, of a semi-popular character adapted for the perusal of any one who desires to know something of a fascinating subject, without having to plunge into mathematico-physical investigations. The latter, however, along with adequate anatomical knowledge, are the only means by which an accurate knowledge of the wonderful sense of hearing can be obtained.

JOHN G. M'KENDRICK.

SCIENCE AND QUARRYING.

Steinbruchindustrie und Steinbruchgeologie. By Dr. O. HERRMANN. 8vo, pp. xvi. + 428, with 6 plates, and 17 figures in the text. Berlin: Gebrüder Borntraeger, 1899. Price 10 marks.

This excellently printed work is, as its author is careful to point out, largely devoted to the stone industries of Saxony; but a general review of useful stones is also undertaken. The list of books helpful to the reader would astound a quarry-owner, but shows how the author is intent on putting forward mineralogical and geological knowledge as the true basis for the practical treatment of rock-masses. We miss, however, from this list Lévy and Lacroix's "Minéraux des roches," and the admirable tables of the same authors. While England is well represented, only three French works seem quoted, which is a loss when one considers the present brilliant position of geology and mineralogy throughout France.

The work opens with a modestly-written description of the common rock-forming minerals, stress being laid on the characters that make their presence welcome or unwelcome in building materials. An account of rocks then follows, based on Zirkel's text-book; but it seems unwise to introduce the question of geological-age at this late period into the classification of the igneous masses. What would a German quarryman think, were he imported into the Mourne Mountains or the Pyrenees? It is a pity, at any rate, to give grounds for the suspicion that geology is a matter of names, and of no value to the "practical tradesman." Pp. 83-150, however, should go far to show how minute structural details, or conditions of original deposition, such as those studied by the geologist, fundamentally affect the utility of rocks when they come to be placed upon the market. We gather from p. 180 that the growth of the artificial stone industry already affects the business of German quarries, and that the rates charged on railways are among the obstacles to progress. The same may be said with greater force of our own islands; and it is a question whether artificial stones, of uniform excellence, may not in time supersede natural ones for city use. This will only be a further example of science applying the tools of nature

to man's general advantage. The lightning-flash is, after all, an uncertain and unruly affair compared with the incandescent electric light.

For ornamental stones, however, it is doubtful if any artificial product should replace the natural; the question here is one of natural beauty as opposed to artificial colouring. Indeed, the startling breccias of some Italian manufacturers seem only parodies of nature. An artificial marble should be as impossible in architecture as an artificial flower-bed in a garden.

Dr. Herrmann's account of the marvellous variety of rocks in Saxony occupies 180 pages, and is followed by an appendix showing the choice of road-metal on Saxon highways. Would that we could echo—especially in Ireland—his conclusion (p. 351) that sandstone, limestone, dolomite, mica-schist, clay-slate, loam, and clay, while covering forty per cent of the surface of the country, are nowhere used as road material! When we see sand and turf-lumps thrown down on the denuded foundations of the fine old Holyhead road, as a metalling of modern days, we could wish for a little more of Dr. Herrmann's science mingled with our British practice.

This useful and agreeable volume concludes with a review of the public purposes to which the best known stones have been applied in various countries. It is a pity that the sumptuous use made of the "Irish green" serpentinous marble in recent work in Dublin could not have been included. The granite of Peterhead naturally comes in for mention, including references to Dublin and to Liverpool. The work involved in the preparation of this catalogue is not to be lightly estimated.

While some of the photographic illustrations are useful, others, such as those of stone-masons' buildings, are hardly in keeping with the work. A few bold pictures of wrought surfaces of stones, taken near at hand, would, to our thinking, be effective in a subsequent edition. G. A. J. C.

MORE APPLIED GEOLOGY.

Applied Geology. Part II. By J. V. ELSDEN, B.Sc. 8vo, pp. vi. + 250, with figs. 58 to 186. London: "The Quarry" Publishing Company, Limited, 1899.

This book is stated by the author to be written both for the geologist and the practical man. The second volume begins with chapter vi., which relates to ore deposits, and contains information of a rudimentary but well-chosen character, coupled with illustrations from various sources, notably from "Ore Deposits" by the late J. A. Phillips.

This chapter is represented by 19 pages of useful matter, illustrations included, and ends with a list of "Common Ores occurring in Mineral Veins," in which stromayerite and melaconite seem hardly common enough, in most localities, to deserve mention. Chapter vii. deals with non-metalliferous minerals. About 19 pages, including illustrations, are devoted to chapter viii., in which notes on prospecting, the recognition of minerals and their paragenesis, quarrying and mining are closely packed, somewhat to their mutual detriment. The four following chapters treat of building and ornamental stones, of these chapter ix. relates to igneous rocks, their modes of occurrence, structure, wearing, etc. On page 68 the reader's attention is arrested by a plan of Dartmoor, which, although it may embody a limited amount of truth, certainly demands an enormous exercise of faith from anyone personally acquainted with the borders of that granitic mass. In the section of the Worcestershire Beacon, Fig. 108, it might have been well to indicate the direction in which the section is drawn, and Fig. 110 appears to bear little or no relation to the adjacent letterpress. The definitions of rock-structures on pages 74 and 75 are in some cases far from satisfactory. The eruptive rocks are described in 14 pages, with some large, well-executed figures, representing their appearance in thin sections under the

microscope. These and certain other figures of microscope sections are, in some instances, rather diagrammatic, but are admirable of their kind. Chapter xi. deals with sedimentary rocks, and gives a short but useful description of sandstones and grits. Then follows chapter xii., describing limestones and slates, with several good illustrations.

Chapter xiii. is headed "Rocks used in the Arts and Manufactures." The reader may find some useful information here; but the two pages on gems might, for practical purposes of identification, just as well have been omitted. Chapters xiv. and xv. are devoted to questions of water-supply, drainage, landslips, tunnelling, road-making, etc. A map of England and Wales is given, showing the distribution of road-stones. It is difficult to say why the Land's End should be marked "syenite," and several additions might be made in other parts of the map; still it is a useful one.

There is an appendix on "Simple and Rough Methods for the Determination of Minerals and Rocks." Suffice it to say that they are simple and rough.

An index, in which Arkose precedes Architectural, and Bauxite comes before Basalt, concludes the volume, which, with its good features improved and its bad ones eliminated, may eventually fulfil the author's praiseworthy object in making it of use both to the geologist and the "practical man." In its present form it will probably better serve the purpose of the latter. The paper, the letterpress, and many of the illustrations are good. There are possibilities about such a book. The general plan of the work indicates a useful motive in a right direction. F. R.

THE MUSEUMS ASSOCIATION.

Report of Proceedings, with the Papers read at the Tenth Annual General Meeting, held in Sheffield—July 4 to 8, 1898. Edited by HERBERT BOLTON. 8vo, pp. 193. London: Dulan and Company, 1899. Price 5s.

"The Editor," we read on p. v., "exceedingly regrets that so long a time has been occupied in completing these Proceedings, which, under ordinary circumstances, ought to have been in the hands of members and associates last October." What the extraordinary circumstances may be we are not informed; but among them may doubtless be reckoned Mr. Bolton's removal to Bristol almost immediately after his appointment as Editor of the Museums Association, and the mass of additional work connected with the rearrangement of large collections in the Bristol Museum and with the British Association Meeting, in which he thus became involved. Considering this, we do not think that Mr. Bolton need be greatly ashamed of having followed the example of previous editors in issuing the report eleven months after the meeting to which it refers.

We miss from the volume before us some of the papers which, according to the programme, were read at the meeting. Curators will regret the absence of Professor W. C. F. Anderson's stimulating remarks on "Museums in relation to Art Teaching," of the valuable suggestions as to "Methods of Preservation and Arrangement of Seaweeds for Exhibition" that came from Professor F. E. Weiss, and especially of the thoroughly practical "Note on some Arrangements and Fittings in the Sheffield Museum," read by the energetic curator of that institution, the enthusiastic secretary of the Association, Mr. E. Howarth. None the less, it would not have been advisable to have delayed publication of the report for the sake of including even these valuable contributions.

The contents of the report are of rather more varied nature than usual. The natural history aspect of museums has had prominence hitherto, but in the present volume are several contributions from the Art side. This is as it should be, for, different though the two branches appear, the curators of each can with profit exchange experiences and hints. Rather more art in the display of

natural objects, rather more system in the exhibition of things artistic, would often not be misplaced. Among the contributions to which we allude, special attention should be paid to that by Mr. James Paton, Superintendent of Museums, Glasgow, giving an authoritative account of the inception, establishment, and maintenance of the "People's Palace" in that city. The question of loan exhibits in museums is always a difficult one, and those who have had to consider it will read with amusement Mr. Paton's witty classification of lenders, and agree with him and Polonius that one should "neither a lender nor a borrower be." Mr. John Maclaughlan, of the Albert Institute Museum, Dundee, writes on "Sculpture in Art Museums," in a way that should be of much use to other provincial curators. Mr. William White's paper on "The Individuality of Museums" is chiefly devoted to an exposition of the Ruskin Museum, of which he is the curator. It is followed by "Practical Notes and Suggestions on Modes of exhibiting Museum Specimens," drawn from Mr. White's experience in the same museum; several of these are original and valuable.

Among articles that refer to all classes of museums, the place of honour is of course due to the address by the genial President, Alderman W. H. Brittain, who gives an account of the labours of the Museum Committee of the Sheffield Corporation. In a paper on "Provincial Museums and the Museums Association" Mr. H. Bolton suggests the compilation of a return of statistics as to the present condition of all museums in the United Kingdom. Such a statement would be of great value to curators, councillors, and educationalists, and we are glad to see that the Association has appointed a committee "to obtain information respecting museums on the lines of Mr. Bolton's paper," and that the General Secretary has been instructed to prepare a form to be sent to museums for their officials to fill up.

Mr. W. E. Hoyle's illustrated account of "The Electric Light Installation in the Manchester Museum" is thoroughly practical, and since that museum seems to have solved many of the difficulties incident to artificial lighting, this paper should be studied with care by all who propose to adopt the electric light for similar institutions. "The cleaning of museums" may seem an obvious duty, and it is just conceivable that the cleaning and dusting of the public portions of most of our modern museums is adequately carried out; but Miss Clara Nördlinger, of the Manchester Museum, cannot emphasise too strongly the need for "a judicious and efficient daily dusting of the workrooms used by the staff"; ventilation is usually lacking in such apartments, while the atmosphere is full of particles of arsenic, corrosive sublimate, and other poisonous and irritating substances. Such rooms are never properly cleaned, except, perhaps, in the Manchester Museum, and the health of the staff suffers in consequence.

Papers of more restricted range, and dealing chiefly with matters of natural science, are the following:—Professor A. Denny of Sheffield, on "The Relation of Museums to Elementary Teaching," which contains nothing more novel than common sense. Mr. E. M. Holmes, of the Pharmaceutical Society, writing on "The Arrangement of Herbaria," describes the methods adopted in various public establishments, and selects from them numerous useful suggestions. He favours the alphabetical arrangement for all small herbaria: undoubtedly it effects a great saving of time. In pursuance of this, he gives an alphabetical list of the natural orders of plants, with the numbers affixed to them in Bentham and Hooker's "Genera Plantarum," and with cross-references to the names used in Engler and Prantl's "Natürlichen Pflanzen-Familien." Dr. H. C. Sorby has yet another note on "Marine Animals mounted as Transparencies for Museum Purposes"; many of his beautiful preparations are to be seen in the Sheffield Public Museum, where they have been exposed to the light for several years without deterioration. Mr. Harlan I. Smith, of the American Museum of Natural History, suggests a detailed classification for "The Ethnological Arrangement of Archaeological Material"; it is thought that it may lead the

collector in the field to procure common objects such as he otherwise might overlook, and this seems to us a thoroughly valuable suggestion. Mr. S. Sinclair describes "The Australian Museum," of which he is the secretary. The last paper in the volume, by Mr. F. A. Bather, of the British Museum (Nat. Hist.), describes "some Russian Museums" visited by him when attending the International Geological Congress in 1897. The account of the Caucasian Museum in Tiflis has a timely interest, since its curator, Dr. G. Radde, has just been awarded the great gold medal of the Russian Geographical Society. Other museums described are those of St. Petersburg, Reval, Jurjev (Dorpat), Moscow, Saratov, Astrakhan, and Theodosia. The notes are mostly geological and zoological, and are followed by the drawing of a few morals, professedly referring to Russia, but peculiarly applicable to museums nearer home.

As usual, a few reviews and notes close the volume; but we regret to see that the Secretary has not furnished any report of the discussion following the papers. Such reports in former years, despite occasional verbosity, contained much useful matter that otherwise would not have achieved publication. We trust that this will be remedied at the next meeting, which we are informed is to be held at Brighton during the first week of July.

CRITICISM WITHOUT KNOWLEDGE.

Views on some of the Phenomena of Nature, as seen from the Workshop, the Factory, and the Field. Part II. By JAMES WALKER. 8vo, pp. 187. London: Swan Sonnenschein and Company, Ltd., 1899. Price 2s. 6d.

Mr. Walker is a paradoxer of the first water. His quarrel with modern science is partly verbal; but the greater part of his booklet is taken up with denunciation of the undulatory theory of light. He takes fright at the largeness of the numbers used to describe the number of vibrations per second in the motion that is the physical concomitant of what we call red light, and imagines that the writing out of these by numbers across a whole line of print is an argument against their existence. He has still to learn the truth that largeness and smallness are purely relative terms, and that the billionth of an inch is as truly a magnitude as the distance from the earth to the sun. It would be vain to attempt any criticism in a short notice. Enough to say, that his representation of the modern theory of light and radiant heat is a travesty, and shows extraordinary ignorance of the elements of wave motion. In support of this statement we give one quotation as a sample. In his description of the production of lightning *according to the science of to-day*, he says, "All, from every single molecule of that vapour, these motions and quivering waves of ether somehow drop the molecules, forsake them, abandon them; and although being nothing themselves but the simple quivers of ether, somehow collect themselves into a flash of an irresistible force of destruction, occupying not one-half of a cubic inch of space," etc. We congratulate our author on this very remarkable theory of the production of the lightning flash. It is his alone! It may be well to point out that, although Mr. Walker scoffs at scientific men for their gratuitous invention of the ether, he himself falls into the same pit by inventing "electrogene," which, so far as may be gathered from the vague references that are made to it, is a kind of material squirted out from the sun. To expose the fallacy of most of his arguments would be wasted labour. *Magna est veritas, et prevalebit;* and it is doubtful if tomes of argument could ever convince Mr. Walker of his sublime ignorance of the real basis of our ethereal dynamics.

C. G. K.

A HISTORY OF EXPERIMENTAL PHYSICS.

Geschichte der physikalische Experimentier-Kunst. By Drs. GERLAND and F. TRAUMÜLLER. 8vo, pp. xvi. + 442, with 425 illustrations. Leipzig: Engelmann, 1899.

To trace from their hazy beginnings the gradual and laborious development of what are now familiar and simple truths is always a fascinating study. If rightly pursued it should give us a psychological insight into the mental modes of man. One great difficulty must ever be the imperfection of the historic imagination. Just as the mature intellect is apt to misinterpret the modes of thought of the child or savage, so we, the heirs of centuries of accumulated knowledge, have difficulty in appreciating the intellectual needs and powers of our ancestors. Where, however, as in the case before us, the mark of the stage of culture arrived at is a mechanical contrivance or an illustrative experiment, there is less play for the personal equation, there is more chance for a sound judgment. Doctors Gerland and Traumüller have put together an extremely interesting book in which is presented, on its purely experimental side, the evolution of physical science from the early days of the Assyrians, Egyptians, and Greeks, through the times of the Middle Ages to the end of the sixteenth century, when with Galileo the modern school of experimental science may be said to have begun, and from this epoch on to our own days. Nearly a century before Galileo's time, however, we find in Leonardo da Vinci—famous even in his own day as painter, sculptor, musician, architect, and engineer—a type of the true scientific spirit. Particularly fruitful were his inventions and discoveries in hydraulics.

To give a fair notion of the contents of the book, suffice it to say that it is chiefly concerned with the invention of such familiar instruments as the telescope, microscope, pendulum, air-pump, thermometer, barometer, hygrometer, the electric machine, voltaic cell, galvanometer, induction coil, telegraph, etc.

The cuts and illustrations are numerous and instructive. Many are reproduced from original sources, and some are of high interest. Perhaps the most curious is the picture of von Guericke's experiment showing two teams of horses (sixteen in all) engaged in "a tug of war," the object being to pull asunder two gigantic Magdeburg hemispheres within which a vacuum has been formed. Very instructive also are the ingenious mechanical devices employed by our scientific forefathers to illustrate or demonstrate important mechanical principles. Not a few of these might with advantage be introduced for demonstrative purposes in our schools and colleges. C. G. K.

POPULAR ENTOMOLOGY.

True Tales of the Insects. By L. N. BADENOCH. 8vo, pp. xviii. + 255, with 44 figs. London: Chapman and Hall, Ltd., 1899. Price 12s.

IT was a happy inspiration of the author to devote most of this handsome volume to insects with stories of such interest and so little hackneyed as are those of the Orthoptera. Though popular in aim the book bears evidence of a true love of entomology and of a knowledge of the creatures described that are far from universal in similar works; and few readers will lay it down without the desire to learn more of its subject. The essays on Lepidoptera, which occupy the last eighty pages, are scarcely equal to the others.

Unfortunately the literary form often leaves a good deal to be desired. Such sentences as these are too frequent:—"Others again can fly, having ample wings, and, oddly enough, often gaily coloured. Look at the large spectre *Acrophylla titan* of Australia, a giant of its kind; its charming wings generally

blackish-brown in colour, but irregularly spotted and banded with white, the costal portion variegated with green and pink, and expand fully eight inches." "The colour of the body in many Phasmidae may change from brown in early life to green, subsequently returning to the brown tint. If this be owing to the presence of chlorophyll or other plant-juices among the insect-tissues, its explanation is not far to seek." "Sir John Hunter" is a slip that probably expresses admiration for his genius.

The illustrations of the insects deserve high praise, and the printer has done his work well. The book fills a place not previously occupied in the literature of entomology, and places within reach of English readers much varied information. The quaint forms and admirable disguises of the leaf-insects and "walking sticks," the methods of capturing prey employed by the mantis, the beauty of colour, the methods of producing sounds, and many other curious traits, are all described here, and should attract students to the Orthoptera, which rarely get the attention they deserve. J. H. W. T.

In the February number of the *American Geologist* Mr. W. S. Gresley throws some "Side-light upon Coal Formation," in adducing evidence that many coal-seams have not undergone any appreciable vertical compression since the time of their formation from decaying vegetation. He also points out that when coal arises from drifted deposits laid out in water, the shale band occurring above the coal may represent that which originally underlay the plant-remains. Such reversals by the agency of denudation, the materials of the highest original bed becoming laid down first in the new area of deposition, then those of the bed below, then those of the next bed, and so on, are of course not uncommon in the geological series.

Mr. J. B. Woodworth writes of the classification of glacial deposits, laying useful stress on the association of "sands and gravels" with the melting of ice-masses *in situ*. In introducing one or two new technical terms he, almost by miracle, avoids the use of Greek, a language which has preponderated in the modern geological literature of America, to the confusion and astonishment of Eastern readers.

Mr. Hovey's report of the winter meeting of the Geological Society of America contains a number of suggestive abstracts. Mr. Walcott's announcement (p. 99) of "plates of crustaceans closely related to Eurypterus" in the Algonkian beds of Montana, 4000 feet below the base of the Cambrian, will be received by palaeontologists with respectful watchfulness. Possibly the lover of thrust-planes will also want to have his say in the matter. At the present time students of variation in igneous magmas will read with interest Mr. Emerson's observations on absorption by granite, quoted on p. 105.

In the March number of the *Naturalist* Mr. O. Grabham gives an account of the bats found in Yorkshire, with notes on their habits in confinement. The absence of attention to recent emendations in nomenclature is as conspicuous in this as in an earlier paper on British bats noticed in these columns. Our own opinion with regard to such emendations is, that it is frequently desirable to "let sleeping dogs lie"; but that when they have once been made by a naturalist of recognised eminence it is the duty of humbler folk to follow suit, and not to presume to have opinions of their own on such subjects.

We are grateful to the editor of *Finland* for sending us a copy of the first number of his beautifully printed, admirably written magazine. The subjects with which it deals, though of enthralling interest, can scarcely claim to be touched on in a scientific journal, except in so far as every worker in science thereby confesses himself a lover and an advocate of freedom, education, and the right to know and think. The offices of *Finland* are at 106 Victoria Street, London, S.W., and the price is 3d. a number.

OBITUARIES.

RUDOLF LEUCKART.

BORN OCTOBER 7, 1822; DIED FEBRUARY 6, 1898.

IT has been a matter of regret to us that no obituary of this great zoologist has previously appeared in our pages,—an omission mainly due to the busy preoccupation of those best qualified to write such a notice. Yet we are not very far behind some of our contemporaries, for the May number of the *Zoologisches Centralblatt* furnishes us with the material on which this note is based.

Rudolf Leuckart was the son of a senator and printer at Helmstedt, and nephew of the zoologist Fr. Sigismund Leuckart. He studied at Göttingen, graduating as Doctor of Medicine in 1845, and was brought much under the influence of Rudolf Wagner, whose assistant he became. After a period of activity as privat docent he was called in 1850 to Giessen as Professor of Zoology in succession to Carl Vogt.

Even in Göttingen he had defined the characteristics of his future work:—(1) by numerous detailed researches, (2) by his generalising essay "Ueber Morphologie und Verwandtschafts-verhältnisse der wirbellosen Thiere," and (3) by helping H. Frey in preparing a second edition of Wagner's "Comparative Anatomy."

Soon after he had settled down in Giessen, where he remained till 1869, he published along with C. Bergmann a treatise which was at the time and still remains a remarkably strong piece of work—the "Anatomisch-physiologische Uebersicht des Thierreichs" (1852). His subsequent essays on polymorphism, division of labour, alternation of generations, parthenogenesis, and especially, perhaps, his article "Zeugung" in Wagner's Dictionary of Physiology (1855), were also notable contributions to the more general problems of Zoology.

In his detailed researches he ranged from Protozoa to Cephalopods, from Siphonophora to Pteropods, from the development of insects to that of the vertebrate eye,—indeed, over the whole animal kingdom,—but the department of study which seems to have fascinated him most, and in connection with which he is best known, was parasitology. To what is now known of the structure and life-history of Trematodes, Cestodes, Nematodes, Acanthocephala, Linguatulidae, etc., Leuckart made very important contributions, many of which were summed up in his famous work, "Die menschlichen Parasiten und die von ihnen herrührenden Krankheiten" (1863-1875). A second edition of this indispensable compendium was begun but, unfortunately, never completed. The first part is well known to students in this country by Mr. Hoyle's translation (1886, Pentland, Edinburgh).

In 1869 Leuckart was called to the professorship of zoology in Leipzig, and there he had wider scope for his enthusiasm and skill as a teacher. To name his students who have become famous would fill a page, and the splendid *Festschrift*

which was dedicated to him on his seventieth birthday affords eloquent testimony of the respect and gratitude of those who had the privilege of sitting at his feet.

The wall-diagrams by Leuckart and Nitsche are almost as familiar to the student as Leuckart's memoirs and his bibliographical Berichte (1848-1879) are to the investigator.

As generaliser, specialist, and teacher, Rudolf Leuckart was certainly one of the great zoologists of the century.

See BÜTSCHLI, O., *Zool. Centralbl.*, vi. 1899, pp. 264-266.
CARUS, J. V., Zur Erinnerung an Rudolf Leuckart, *Ber. Ges. Wiss. Leipzig*, 1898, pp. 51-62.
BLANCHARD, R., Notices biographiques. I., R. Leuckart. Avec portrait. *Arch. Parasitol.* 1898, pp. 185-190.
GROBBEN, C., Rudolf Leuckart. Ein Nachruf. *Verh. Zool.-bot. Ges. Wien.* 1898, 5 pp.
JACOBI, A., Rudolf Leuckart. Mit Porträt. *Centralbl. Bakteriol.* xxiii. 1898, pp. 1073-1081.

X.

The death is reported by telegram of Mr. JOHN WHITEHEAD, the well-known collector and explorer, who succumbed to an attack of pestilential fever while on a scientific mission in the island of Hainan. He left England in the autumn of last year to explore the less known islands of the Philippine group. On his arrival at Manilla, he found the condition of things too disturbed to permit of his going into the interior, and so made his way to Hainan, the highlands of which have never been traversed by European. Mr. Whitehead has during the last three years been engaged in the exploration of the Philippines, and by his work he added greatly to our knowledge of the zoology of the group. In his last expedition to the island of Luzon, Mr. Whitehead made an unexpected discovery in the shape of a new and peculiar mammal fauna inhabiting the Luzon highlands, and believed to be isolated on a small plateau on the top of Mont Data, in the centre of northern Luzon at an altitude of from 7000 to 8000 feet. As a collector Mr. Whitehead was highly esteemed, and his death at the early age of 43 will be especially felt in the Natural History Museum at South Kensington, the zoological collections in which have been enriched through his industry and skill.

The deaths are also announced of Prof. L. A. CHARPENTIER of the Faculty of Medicine, Paris; on April 20, at Montauban, Prof. CHARLES FRIEDEL (b. 1832), one of the most distinguished of French chemists, and one of the initiators of the French Association for the Advancement of Science; Dr. THEODOR VON HESSLING, formerly professor of anatomy in the University of Munich, at the age of 83 years; on May 6, aged 73, the Rev. T. NEVILLE HUTCHINSON, who was science master at Rugby from 1866-83, and did much to introduce the study of science in the English public schools; on May 17, the Rev. JONATHAN SHORT, vicar of Hoghton, near Preston, in his 74th year. He was well known as a geologist and antiquarian throughout the North of England, and has taken an active part in collecting and preserving the historical records of Lancashire.

NEWS.

THE following appointments have recently been made:—Dr. Howard Ayers, professor of biology in Missouri University, to be president of the University of Cincinnati; Dr. Tarlton H. Bean, to be director of forestry and fisheries of the United States Commission to the Paris Exposition of 1900; Dr. C. E. Beecher, professor of historical geology in Yale University, to succeed the late Prof. O. C. Marsh as curator of the geological collections of the Peabody Museum, and to be a member of the executive council of the museum; Miss Edith Chick, as Quain student in botany for three years at University College, London; W. R. Crane of Janesville, Wis., to be assistant professor of mining engineering at Kansas University; Dr. G. Davis, to be assistant professor of applied anatomy at the University of Pennsylvania; Dr. Ida Hyde of Cambridge, Mass., to be assistant professor of zoology at Kansas University; Miss A. Lambert, M.Sc., to be assistant lecturer in biology in the University of Melbourne; Dr. G. Lindau, to be Custos of the Imperial Botanical Museum of Berlin; Miss Lillie J. Martin, to be acting assistant professor of psychology in Stanford University during Dr. Frank Angell's absence in Europe; Prof. E. A. Schäfer, F.R.S. of University College, London, to be professor of physiology in the University of Edinburgh, in succession to the late Prof. Rutherford; Dr. J. L. Wortman, of the American Museum of Natural History, to take charge of the new collections of fossil vertebrata in the Carnegie Museum, Pittsburgh.

Mr. F. J. Bennett has resigned his position on the Geological Survey of England, after 30 years' service, during which he has mapped large areas of Cretaceous and later rocks in Surrey, Berks, Wilts, and the eastern counties.

We regret to learn that it was owing to medical orders that Prof. E. Ray Lankester was compelled to withdraw his promise to deliver the "Robert Boyle" lecture at Oxford this summer. He has been recruiting his health by a trip to various Continental museums. The Boyle lecture was delivered on June 6, by Prof. J. G. M'Kendrick, who took for his subject the physiological perception of musical tone.

On the occasion of the birthday of Her Majesty the Queen, the following among other honours have been bestowed:—a baronetcy was conferred on Prof. J. S. Burdon Sanderson, and the honour of knighthood on Dr. W. Mitchell Banks and Dr. John Sibbald. Mr. Stanley was appointed to be G.C.B., and Prof. Michael Foster to be K.C.B. Dr. J. C. Meredith, secretary of the Royal University of Ireland, is also among the new knights.

In a convocation at Oxford on May 16, the degree of M.A. (*honoris causa*) was conferred upon Mr. Roland Trimen, F.R.S., formerly curator of the South African Museum, Cape Town, and late president of the Entomological Society of London.

On June 21, at the Oxford Commemoration, the honorary degree of D.C.L. was conferred *inter alios* on F. D. Godman, F.R.S., and on Mr. J. G. Frazer, M.A., Fellow of Trinity.

On June 8, a number of foreign guests who had been present at the Stokes jubilee celebration and the Royal Institution centenary, were entertained at Oxford, and, in a convocation, the honorary degree of D.C.L. was conferred on Profs. Becquerel, Körner, Liebreich, Moissan, and Newcomb.

At a congregation at Cambridge on May 11, the degree of Doctor in Science (*honoris causa*), was conferred on Alexander Kowalevsky, the illustrious professor of zoology in the Imperial University of St. Petersburg.

On June 2 the University of Cambridge conferred honorary degrees on Professors Cornu, Darboux (Paris), Kohlrausch (Berlin), Michelson (Chicago), Mittag-Leffler (Stockholm), Quincke (Heidelberg), and Voigt (Göttingen).

Mr. Prillieux has been nominated member of the Academy of Science, Paris, in the botanical section, in place of the late Ch. Naudin.

The St. Petersburg Geographical Society has awarded its great gold medal to Dr. G. Radde, Director of the Caucasian Museum at Tiflis.

Mr. Alexander Agassiz has been elected president of the American Academy of Art and Sciences.

The gold medal of the Linnaean Society has been this year awarded to Mr. J. G. Baker, the well-known botanist of Kew.

The following naturalists have been elected foreign members of the Linnaean Society:—Adrien Franchet (Paris), E. C. Hansen (Copenhagen), Seiitsiro Ikeno (Tokyo), E. von Martens (Berlin), and G. O. Sars (Christiania).

It has been resolved to establish a professorship of Agriculture at Cambridge, subject to the following regulations:—The professor shall teach and illustrate the principles of Agriculture, apply himself to the advancement of the knowledge of the subject, and undertake the direction of the Department of Agriculture in connection with the University. The Professorship shall exist for ten years, and longer should the University so decide, and it shall not be tenable with any other Professorship or Readership in the University. The stipend shall be £800 per annum, or £600 per annum should the Professor hold a Fellowship. The Professor shall be connected with the Special Board of Studies for Biology and Geology, and shall be a member, *ex officio*, of the Special Board of Physics and Chemistry, and of the Board of Agricultural Studies.

Convocation at Oxford on May 16 passed a decree authorising the University chest to receive for the next five years £400 per annum from the Royal Geographical Society, and to pay the same to the common university fund, and also to pay that fund during the same period £100 per annum from the chest, the sums so paid to be applied to the furtherance of geographical study in Oxford. A provisional scheme for the teaching and study of geography has already been arranged.

The appeal made some time ago by the Duke of Devonshire, as Chancellor of the University of Cambridge, for financial assistance to the university, is meeting with substantial support, the list published showing promises which amount to over £50,000.

A statue of Charles Darwin by Mr. Hope Pinker, which has been presented to Oxford University by Mr. Edward B. Poulton, M.A., Fellow of Jesus College, Hope Professor of Zoology, was inaugurated at the University Museum, and an address was delivered by Sir Joseph D. Hooker, K.C.S.I., F.R.S., Hon. D.C.L. The Vice-Chancellor (the President of Corpus) presided, and among those present were Professor Charles Darwin of Cambridge, Sir

John Conray, Sir J. S. Burdon Sanderson, and Professor Poulton. The Chancellor, in opening the proceedings, said Darwin's method and Darwin's conceptions were applicable to the whole range of knowledge, and had been extended to numerous fields of research which probably, at the beginning of his speculations, never entered within his own purview. The historical method which had been so fertile in its results was indeed known and practised before the time of Darwin, but it was mainly owing to Darwin's splendid applications and illustrations of it in the natural sciences that it had now become the acknowledged and generally received instrument of inquiry in the sciences of mind, morals, aesthetics, language, society, politics, law, religion, and in fact every subject connected with the constitution of history and the capacities of man. The statue, which was pronounced as a remarkable likeness of Mr. Darwin, was unveiled amidst loud cheers.

The Johnson Memorial Prize of the University of Oxford has been awarded to Mr. H. N. Dickson of New College, for his work on the distribution of water and currents in the North Sea.

Women's munificence to universities and colleges in the past has generally taken the form of bequests, but Aberdeen recently received a handsome gift during a lady's lifetime. Miss Cruickshank, daughter of Dr. John Cruickshank, Professor of Mathematics in Marischal College from 1817 to 1860, gave not long ago £15,000 to establish a botanical garden in the city for the use of university students and the general public. The garden will be about five acres in extent, and situated in Old Aberdeen. It is intended to perpetuate the memory of Mr. Alexander Cruickshank, LL.D., brother of the donor, who was devoted to scientific pursuits, especially botany and geology, and who died about two years ago. The laying out of the garden is now in rapid progress under Prof. Trail's supervision. There will also be a physiological laboratory and other important adjuncts.

The North London Natural History Society sends us its programme for the latter half of this year. There are excursions to Broxbourne, Tring, Eynsford, Lambourn, Epping Forest, Kew Gardens, and "South Kensington Museum," as well as cycle runs. The papers offered seem to be, for the most part, of a general nature. Meetings are held at the Sigdon Road Board School, Dalston Lane, close to Hackney Down Station, and begin at 7.45 p.m. Those who wish to become members should apply to the Secretary, Mr. L. B. Prout, F.E.S., 246 Richmond Road, Dalston, N.E.

From the *Times* of June 15 we learn that Sir Harry Johnston devotes a section of his new report on Tunis to an account of the measures taken there for educating the native population. In the course of this he gives a very interesting account of the "Mosque of the Olive Tree" (Jama-Ez-Zituna) at Tunis, one of the three great centres of Mahommedan learning in North Africa, the others being El Azbar in Cairo and the Great Mosque at Fez, in Morocco. This Zituna still remains a great centre of teaching. It is an immense building with 161 porphyry columns, lit only by many open doors. Outside the main building is a vast square, surrounded by a colonnade, at one end of which is an immense minaret. Within the main building, where the porphyry columns are, is the sacred shrine, and in this main building the professors teach and the students learn. The institution has a valuable library of Arab books and manuscripts, some of which are said to have come from the famous library of Alexandria destroyed by the first Mahommedan invader of Egypt. Over 400 students are usually taught at this university, while there are about 100 professors. The lectures begin at sunrise and continue until sunset, 15 different lectures usually going on at the same time. Each professor sits cross-legged, with his back against one of the many columns of the mosque, his students grouped about him. The latter vary in age from 16 to 30, but occasionally are men of advanced middle age. They can choose their own professors, but are constrained to some

extent as to the course of teaching it is considered best for them to follow. They live near the mosque in *medressahs*, or lodgings, of which there are 22, each presided over by a sheikh or elder. The instruction is chiefly in theology, rhetoric, logic, grammar, law, and medicine, and much obsolete and useless teaching is given under these heads. Until recently there was but little method in the instruction; each professor rambled on in his discourse, ranging over any topic on which he cared to impart information, and the students listened or not as they chose. To encourage a more practical education, the State offered the students exemption from military service and from certain taxes if they passed an elementary outside examination; but only 4 of 66 recently succeeded in doing this. In future it is intended to impress on the management of the mosque that each professor should keep to one subject; that the students should be obliged to take notes and pass periodical examinations. Outside lectures on scientific subjects and on matters of present-day interest have also been established, and about 100 students from the mosque attend these.

The foundation-stone of a Museum of Oceanography was laid at Monaco on April 25. It will house the collections of the *Princess Alice*, and will include laboratories.

The salary of an assistant in zoology at the New York State Museum is $900, about £187 : 10s. This sounds promising. It is a pity that the notice of the last examination was not issued in time for the out-of-work zoologists in this country to send in their names.

The collection of shells of the late Mr. Henry D. Van Nostrand, recently given to Columbia University, is, says *Science*, well known among malacologists as one of the most valuable of private collections in the country; it contains the larger and better portion of the land shells of the West Indies collected by Thomas Bland, including many types, together with many of the rarest specimens of the Perry Expedition.

The Ballestier collection of shells from the East Indies made at the beginning of this century, has been presented by the heirs of Warren Delano to Harvard University, which has also obtained Mr. E. Elsworth Call's collection of American land shells.

The Gray Herbarium of Harvard University has, says the *American Naturalist*, recently purchased a collection of Compositae of the late Dr. F. W. Klapp, of Hamburg. It contains about 11,000 specimens, and will probably add 60 genera, 1500 species, to the Gray Herbarium, which previously contained 35,000 sheets of composites.

Dr. Daniel G. Brinton, professor of American Archaeology and Linguistics at the University of Pennsylvania, has presented to the University his collection of books and manuscripts relating to the aboriginal languages of North and South America. According to *Science*, the collection represents a work of accumulation of twenty-five years, and embraces about 2000 volumes, in addition to nearly 200 volumes of bound and indexed pamphlets bearing on the ethnology of the American Indians. Many of the manuscripts are unique. A number of the printed volumes are rare or unique and of considerable bibliographical importance. The collection of works on the hieroglyphic writings of the natives of this country embraces nearly every publication on the subject. The special feature of the library is that it covers the whole American field—North, Central, and South—and was formed for the special purpose of comparative study.

The new building erected in the Dublin Zoological Gardens in memory of the late Professor Samuel Haughton was formally opened on May 19 by the Lord-Lieutenant, in the presence of a large gathering.

The *Booth Free Library Museum and Technical School Journal* shows that every effort is made by Mr. J. J. Ogle to widen the influence of these institutions.

Popular lectures on birds have been delivered in the Museum, illustrated by specimens in the cases and books brought in from the Library; and the notes are now printed in the *Journal*.

This year no appropriation has been made for the New York State weather service. The sum is only $4500 dollars per annum, but with the volunteer aid of nearly 2500 persons, it has been enough to maintain a weather signal station in conjunction with the Bureau at Washington, to publish weekly "Crop Bulletins," much appreciated by the farmers, and to carry on observations, and numerous stations, some of which have continuous records for thirty years. "This interruption," says *Science*, "will make a break in the files which can never be repaired."

In its fifth session, which will be held in Germany in 1901, the International Congress of Zoology will award for the third time the prize founded by His Majesty the Tzar Nicolas II. The following subjects are proposed, though the whole need not be dealt with:—"Influence of light on the development of colours in Lepidoptera: the causes determining the differences of colours, form, and structure of parts covered during the resting position in insects."

The memoirs presented may be in manuscript or printed; in the latter case their date of publication must be subsequent to September 1898. They should be written in French, and addressed before the 1st of May 1901 to Prof. A. Milne-Edwards, 57 Rue Cuvier, Paris, or to Prof. R. Blanchard, 226 Boulevard Saint Germain, Paris. According to rule, naturalists belonging to the country in which the Congress is to be held are not eligible.

The 69th meeting of the British Association will commence, on September 13, at Dover, under the presidency of Professor Sir Michael Foster, who will deliver an address at 8 P.M. At two evening meetings, which will begin at 8.30 P.M., discourses will be delivered on September 15 by Professor Charles Richet, and on September 18 by Professor J. A. Fleming. The concluding meeting will be held on Wednesday, September 20, at 2.30 P.M., when the association will be adjourned to its next place of meeting.

The following are the titles of the sections and the names of the members who have been nominated by the Council for the office of President of Sections:—(A.) Mathematical and Physical Science, Prof. J. H. Poynting; (B.) Chemistry, Mr. Horace T. Brown; (C.) Geology, Sir Archibald Geikie; (D.) Zoology, Mr. Adam Sedgwick; (E.) Geography, Sir John Murray; (F.) Economic Science and Statistics, Mr. Henry Higgs; (G.) Mechanical Science, Sir W. H. White; (H.) Anthropology, Mr. C. H. Read; (I.) Physiology, Dr. J. N. Langley; (K.) Botany, Sir George King.

The meeting will have the special feature of being of an International character, as an interchange of visits has been arranged with the French Association for the Advancement of Science, which will hold its meeting this year at Boulogne. The members of the French Association will visit Dover on Saturday, September 16; and it is proposed that a formal reception of the visitors shall take place in the morning before the proceedings of the Sections begin, which they are invited to attend. The members of the British Association are invited to visit Boulogne on the following Thursday.

The Mayors and Corporations of Dover and Canterbury, the Military Authorities of the South-Eastern District, and the leading Scientific and Educational Institutions have signified their desire to take part in the entertainment of the Association.

The Castle, Docks, and National Harbour Works will be open for inspection during the meeting. Excursions will be arranged to places of interest in the neighbourhood of Dover, and there will be special Geological excursions in the afternoons. Excursions will also be arranged to Calais and Ostend, and a longer one to towns of Northern France and Belgium at the conclusion of the meeting.

The Reception Rooms will be at Dover College, in the old building of the Priory, close to the Priory Station (L.C.D. Railway), and within a few minutes' walk of the Sectional meetings, most of which are arranged to take place in the Municipal Technical Schools and adjoining buildings.

From the unique character of the meeting and the historical importance of the town in which it is held, a large attendance is expected.

At the annual meeting of the Royal Geographical Society Sir Clement Markham reviewed the geographical work of the past twelve months. In the course of his summary, Sir Clement touched on most parts of the earth's surface, and paid in passing a compliment to Major Marchand, the scientific results of whose journey across Africa could not, he said, fail to be very important. Sir Clement was able to give numerous hitherto unpublished details as to the progress of the *Southern Cross* expedition, of which Mr. Borchgrevinck is in command, but his main references to the Antarctic referred to the national expedition which is being organised under the joint auspices of the Royal and the Royal Geographical Societies. With obvious gratification he also referred to the establishment of a geographical school at the University of Oxford as "crowning the edifice of the Society's educational policy." The President was also able to announce the completion of a task of great magnitude and importance, in which the Society's librarian, Dr. Hugh Robert Mill, has been engaged for some years past—a complete geographical catalogue. This catalogue is a practically exhaustive list of the literature of every part of the earth's surface. It contains at present 100,850 cards, and is, of course, only available in the library of the Society, but it is to be hoped that it may at no very distant date be printed, and so made available for students generally. Another work of great utility to which Sir Clement referred was the preparation of an authoritative list of geographical terms, with definitions. To effect this, a special Nomenclature Committee has been appointed, and when its work is completed many persons besides professional geographers will have reason to be grateful. Unfortunately, neither of the gold medallists of this year could attend personally, Mr. Foureau being far away in the heart of Africa, and Captain Binger too much occupied with his duties at the French Colonial Office to come to London; so the medals were received on their behalf by the military attaché of the French Embassy. Another medal was presented—the gold medal of the American Geographical Society—which the American Ambassador handed to Sir John Murray, in recognition of his many brilliant services to geographical science.

The International Hydrographic and Biological Congress, which is to discuss the arrangement of periodical researches into the conditions of the North Sea and North Atlantic, was opened at Stockholm on June 16.

The Société Helvétique des Sciences Naturelles will meet at Neuchâtel from July 31 to August 2. A due proportion of discourses and excursions are intimated.

At the Geographical Congress at Berlin, this summer, the languages to be used will be limited to English, French, German, and Italian. The *Scientific American* notes a protest in the review published by the Madrid Geographical Society against the exclusion of the Spanish language, in view of the fact that it was spoken by most of the discoverers and colonists of a large part of the world. The writer says, if more geographers were able to read Spanish they would not from time to time bring forth facts as new which were printed in Spanish books two or three centuries ago.

The thirtieth volume of the *Report and Transactions of the Cardiff Naturalist's Society* for 1897-98, published 1899, as is so lamentably common in such cases (though in this case the delay is said to be accidental), has not been sent to us, which seems to us a mistake on the Society's part. It affords

evidence of the flourishing condition of the Society, which has 460 members, and it chronicles a creditable amount of appropriate work. We observe that the Society enlivens its autonomic functions by inviting experts from outside to give public lectures, and in this they seem to have proved their wisdom practically as well as theoretically, for they made a profit of about £125 on one lecture.

At the annual congress of the South-Eastern Union of Scientific Societies held at Rochester at the end of May, Mr. W. Whitaker, the President, gave an address on the "Deep-seated Geology of the Rochester District," and there were papers by Mr. Benjamin Harrison on plateau implements; Mr. J. J. Walker on collecting Coleoptera; Mr. G. F. Chambers on eclipses; Prof. G. S. Boulger on botanical bibliography and records; Mr. J. Hepworth on the history of the *Rochester Naturalist;* Mr. Paul Mathews on ideals of natural history societies; Mr. C. Bird on the position of science in education; Mr. E. Connold on vegetable galls. Prof. Howes was elected president of the 1900 Congress to be held at Brighton.

A striking result of the "Valdivia" expedition, in regard to which one naturally wishes to have more details, is (as translated in *Nature* from Dr. Supan's summary in the April number of *Petermann's Mittheilungen*) that "the quantity of plankton (in Antarctic waters) increases down to about 2000 metres, diminishing rapidly at greater depths, although no level is destitute of animal life. The quantity of vegetable plankton, on the other hand, reaches its lowest within 300 or 400 metres of the surface. The characteristic of the Antarctic plankton is the abundance of diatoms, and the occurrence of special forms; the appearance of the Antarctic type begins as far north as 40° S., but in 50° S. the presence of forms belonging to warmer seas is still noticeable."

Science for May 26 contains an account of ethnological work on the island of Saghalin by Dr. Berthold Laufer of the Morris K. Jesup North Pacific Expedition. There are certain differences between the Ainu of this country and those of Yezzo; their numeral systems is decimal not vigesimal, their dialect is more archaic, and its phonetics richer. Dr. Laufer has obtained explanations of many of their decorative designs, and much information as to traditions. Measurements were difficult to take, but the hairy nature, at least of Saghalin Ainu, is not so great as supposed. From the Olcha Tungus Dr. Laufer obtained wooden idols and amulets of fish-skin. Among the Gilyak he saw many secret ceremonies, and he induced both Gilyak and Tungus to sing into his phonograph. Altogether an excellent record of work, with suggestions of some excitement, danger, and hardship.

Dr. Zwingle, representing the Department of Agriculture of the United States, is now in Morocco on a mission which may open a new industry in the most arid sections of the South-west. It has been found that date-palms, with some irrigation, will grow as well in Arizona as in Arabia. Dr. Zwingle is making a study of the African date-palm, selecting the varieties best adapted to the American arid region.

Mr. C. A. Harrison, Jr., Mr. W. H. Furness, and Dr. H. M. Hiller, who recently returned from an exploration of Borneo, with collections for the University of Pennsylvania, are, we learn from *Science*, about to start on another expedition. They expect to make explorations in the northern part of Burma and make archaeological and ethnological collections.

Professor Gustave Gilson, of Louvain University, Belgium, has begun, under the direction of the Government of Belgium, a series of experiments in the North Sea resembling the observations conducted by Mr. Garstang from Plymouth. On April 29 a set of bottles was let off from the West Hindar light vessel, 2° 26′ E., 51° 23′ N., *i.e.* about 20 miles north-west of Ostend.

Each bottle contains a printed card, and it is hoped that any one who picks up one of these bottles will take out the card and fill up the blanks reserved for the place and date of finding, name and place if found on the shore, latitude and longitude if found on the sea, and send it to Professor Gilson.

A preliminary report upon the results of the scientific expedition to the island of Socotra has been issued by Mr. Henry O. Forbes, Director of Museums to the Liverpool Corporation, who, under the auspices of the Royal and Royal Geographical Societies of London, and of the British Association, and in conjunction with Mr. W. R. Ogilvie Grant, representing the British Museum, undertook the investigation of the natural history of the island. The expedition occupied a period of about six months, and the investigations were conducted amid considerable difficulties. At one time all the members of the party were laid down by a pernicious form of malaria, and they also suffered from frequent attacks of fever. The party were fortunate in discovering many new species of plants and animals, and a valuable collection has been brought home. According to the report the Socotrians are only poorly civilised Mahommedans, living in caves or rude cyclopean huts, and possessing but few utensils, implements, or ornaments, and no weapons. The ethnographical collection is consequently small. The plant specimens have been handed to a well-known student of the flora of Socotra, Professor I. Bayley Balfour of Edinburgh University, who describes them as of high scientific interest, and of great commercial value. The cultivation of some is being undertaken in the Royal Botanic Garden at Edinburgh. The report concludes by congratulating Liverpool on being the first provincial Corporation to further the advancement and increase of knowledge by actively sharing in the investigation of unknown regions.

The Indian Marine Service steamer, the *Investigator*, has recently closed a season of surveying, with important results both for navigation and zoology. The *Investigator*, starting from the Moulmein river in Burma last January, steadily surveyed—and her Surgeon-Naturalist, Captain Anderson, trawled—across the bay to the northern end of the great Andaman, and fixed the position of the island for the first time. Thence the longitudinal position of Port Blair, the capital of the penal settlement of the Government of India, was fixed by running a meridian distance to Double Island, off Burma. When at work in the Middle Straits between the two largest islands, the ship's staff had the assistance of forty tamed Andamanese pigmies against their as yet savage countrymen, who of late have killed several of the Indian convicts near Port Blair with poisoned arrows. The fifteen islands in the three groups of the Cocos, four Andamans and nine Nicobars, will henceforth be a help instead of a danger to the busy mercantile marine plying between Calcutta, Madras, Burma, and the Straits Settlements. The deep-sea trawl went down in some cases from 480 to 800 fathoms, from which Dr. Anderson brought up not a few valuable additions to his collections.

It is reported that the Duke of Abruzzi, the nephew of King Humbert, has started for Franz Josef Land, intending to penetrate as far as possible by ship, and then to make a rush for the Pole with sleighs.

Early in May a party of scientific men started for Alaska as the guests of Mr. Edward H. Harriman, of New York. Among those taking part in the expedition are Prof. Prichard, of the United States Coast Survey; Prof. Coville, of the Department of Agriculture; Prof. C. Hart Merriam, of the Smithsonian Institution; and Prof. William Trelease, of the Missouri Botanical Gardens. The American Museum of Natural History is represented by Frank Chapman and John Rowley, the Field Columbian Museum by Daniel G. Elliott, Amherst College by Prof. Emerson, Leland Stanford University by Prof. Gilbert. Messrs. R. Swain Gifford and Louis Agassiz Fuertes will go with the expedition as artists.

Mr. H. J. Mackinder, reader in geography at Oxford, has gone in charge of an expedition to explore Mount Kenia, in British East Africa.

We are glad to notice that the Technical Instruction Committee of the Liverpool City Council has been enlightened enough to set a good example, in arranging with Prof. W. A. Herdman to give a short course of lectures and demonstrations to help teachers in schools towards imparting sound instruction in natural science.

A discovery of coal, to which much importance is attached by geologists as bearing upon the coal seams pierced in Kent, is announced. The boring is situated a few miles south-east of Calais, and is one of several which have been put down, under the direction of Mr. Breton, the French geologist. The seam struck is two feet six inches thick, and is pronounced to be equal to the best quality of Welsh steam coal.

The *Scientific American* notes Dr. Koeppe's contention that distilled water is decidedly deleterious to protoplasm, absorbing from the same saline constituents and swelling its tissue even to the extent of destroying the vitality of the cells. Distilled water has a similar action on the cells of the stomach, producing in some cases vomiting and catarrhal troubles. He concludes that the toxic property of certain glacier and spring water is due to its absolute purity, which also explains why the sucking of ice and drinking of glacier water sometimes causes stomach derangement.

Dr. D. Hansemann has reported on the brain and skull of von Helmholtz. The head was about equal to Bismarck's, the brain was about 100 grams heavier than the average, the sulci were very deep and well marked especially in the frontal convolutions. Like Cuvier, Helmholtz was somewhat hydrocephalous in youth; and it has been suggested by competent authorities that this state, by enlarging the skull and allowing the brain more room to grow, may be rather an advantage than otherwise.